Design Recommendations for a Digital Social Skills Game for Deaf Students:

A research enquiry utilising qualitative research and goal-directed design methods

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ABSTRACT

The primary aim of this thesis is to provide design and user experience recommendations for a digital social skills and pragmatics game for deaf and hard of hearing students. Research frameworks employed are goal-directed design and qualitative analysis by way of focus groups, semi-structured interviews with parents and teachers students and methods used within grounded theory. A key intention of the game intervention is to improve social skills by providing students with an effective and engaging learning tool. The overall purpose of the game is thus to increase the exposure deaf and hard of hearing students have to effective social communication strategies, and to promote positive self-identity.

The author's research contribution was to support the design endeavour with qualitative user research that identified key user experience themes, unearthed common social skills and communication patterns to target, and developed analysis and insight for the future development cycle. The design artefacts produced include personas, scenarios and scene recommendations to inform the future design of an effective social skills intervention for d/Deaf and hard of hearing students.

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ABBREVIATIONS AND KEY WORDS.

ASD/s	Autism Spectrum Disorder/s
AUSLAN	Australian Sign Language
CI	Cochlear Implant
Co-Design	Design that involves the people being designed for
Design Artefact	Tangible objects produced during the design effort
DHH	Deaf and Hard of Hearing
deaf	Someone with hearing loss
Deaf	Culturally Deaf (usually communicates with NZSL)
FM System	Frequency Modulation System (used by educators)
GBL	Game-Based Learning
GDD	Goal Directed Design
HH	Hard of Hearing
HA	Hearing Aid
HCD	Human-Centered Design
Ideation	Brainstorming activities to produce ideas and concepts
NZSL	New Zealand Sign Language
Persona	Design tool that describes an archetypical user
RTD	Resource Teacher of the Deaf
SENCO	Special Educational Needs Coordinator
SLT	Speech-Language Therapist

SDT	Self-Determination Theory
SME	Subject Matter Expert
Scenario	A day in the life of the persona
TA	Teacher Aide
TOD	Teacher of the Deaf
UCD	User-Centered Design

CHAPTER 1: INTRODUCTION

This chapter introduces the organization of the thesis, the driving research questions, and the key concepts and frameworks employed. Given the multidisciplinary and complex nature of the research, enquiry is presented thematically. For example 'Social Skills, Communication and Pragmatics'; 'Games and User Experience'; and 'Identity, Culture and Relationships'. These all describe critical areas of consideration for the proposed intervention. The selection of methods appropriate to each research area is described and a rationale provided for inclusion within the scope of the thesis research, with further detail provided in each of the relevant chapters.

The primary research question that drove the research was '*How can we best design a digital social skills game for deaf and hard of hearing students?*' This can also be thought of as a problem statement akin to those recommended by Cooper et al in About Face (Cooper, 2014) (p110). This question was formulated following consultation with a subject matter expert interested in creating a game for deaf students. Driven by a perceived lack of resources that effectively supported Deaf students' development of social communication skills, the production of a simple game prototype had begun. The particular need for this by deaf and hard of hearing students was perceived to be due to fewer opportunities for incidental learning, a flow-on effect of having limited access to sound. Other implications of lower access to sound concern the delay of vocabulary, cognition and a number of crucial social pragmatics areas, which is outlined in more detail in the related work and results chapters of the thesis. Given the exploratory nature of the research, a grounded theory and goal-directed framework was determined as the most appropriate way to address the research question.

Breaking down the primary research question into separate segments, the areas of research interest were thus *optimal design for deaf students*, *social and pragmatic skills* and *game and user experience*. Each a rich field of research interest, a cross-disciplinary approach was determined necessary to address these concepts.

Human-centered design was selected as the primary research framework to uncover the requirements of the users of the proposed intervention. It was deemed necessary to gather primary data due to the dearth of research in the area of technology-based social skills interventions for DHH students. The complete list of research questions was thus:

1. *How can we best design a digital social skills game for deaf and hard of hearing students? What are some salient themes that emerge from the primary data that could be useful for designing digital social skills interventions for DHH students?*
2. *Who are the potential users and which characteristics are shared amongst respondents? Are there patterns of how DHH students communicate with others or what they might need in this area? What are user's goals and motivations?*
3. *What would an intervention in this area require in order to be effective and desirable, according to parents and educators? What are the recommendations and experiences of educators and parents?*
4. *What can be learned from interventions developed for students with Autism Spectrum Disorders? What are some transferable lessons for use in the design of a DHH intervention?*

The scope of the project was to define themes relevant to the requirements definition phase of a digital social pragmatics intervention (Cooper, 2014, p. 26). The findings from

the primary data and literature review informed the design advice presented in the user experience recommendations and design chapter and are further discussed in the results and discussion chapters.

CHAPTER 2: BACKGROUND AND RELATED WORK

Related work relevant to the research questions is outlined in this chapter, and includes the findings from a systematic literature review conducted with other researchers in addition to the author's own research into social pragmatics and human-centered frameworks and methods. The chapter is divided into the following sections: Social pragmatics and associated impact on d/Deaf and Hard of Hearing Students, Design frameworks, Game-Based Learning, and finally the systematic literature review into existing interventions for DHH students, and students with ASDs where the nature of the intervention has transferable applicability for DHH students.

Social Skills and Pragmatics

Following a process of SME (Subject Matter Expert) consultation and informal observation, key areas of pragmatics emerged as important for research consideration. These were: self-efficacy, self-advocacy, stigma, contextual barriers, conversational repair strategies and theory of mind. Additional searches were undertaken to ascertain the current state of education practices in regards to social pragmatics areas. As Beal-Alvarez and Cannon state, the work in the area of technology-based interventions for DHH students is lacking, with few intervention studies meeting quality criteria (Beal-Alvarez & Cannon, 2014). Though their work focused on reviewing the work on interventions for educational purposes the authors describe a paucity of research that exists in this area (Beal-Alvarez & Cannon, 2014). The areas of principal research interest are summarized in the following section with descriptions of how they relate to the research enquiry.

Conversational Repair

Conversational repair describes an individual's strategies for resolving communication errors or breakdowns in conversation, for example employing clarification requests such as asking a conversational partner to repeat a question, and seeking to address gaps in the information transmission process. When compared with their hearing peers, DHH students routinely struggle in this area, as Yoshinago-Itano's work in the language skills of DHH students illustrates. Though DHH students may demonstrate general language ability on a comparable level to hearing students, they are often specifically delayed in their development of clarification, questioning and repair strategies. The areas in Yoshinago-Itano's study that were most significantly delayed for DHH students compared to their hearing peers were pragmatic language areas and included 14 items in this area, for example 'repair incomplete sentences' and 'ask questions to problem solve' (Yoshinaga-Itano, 2015). The area of pragmatic language, specifically conversational repair is thus of research and intervention relevance given its connection to problem solving and understanding.

Despite advancements in audiology supports such as the Cochlear Implant, repair techniques employed by DHH students can still be lacking, as Church and Toe found in their investigation of the repair strategies employed by children with cochlear implants (Church, Paatsch, & Toe, 2017). In their study, children with CI's chose not to initiate repair made by their conversation partner who was hearing (ibid).

Contextual Barriers

Contextual Barriers are barriers to communication that the deaf or hard of hearing individual might experience, which limit their ability for full inclusion in the communication context. Reflection regarding contextual barriers is required when

considering how to support DHH students, especially as the majority of these students are educated in mainstream schools and classrooms. Mainstreaming of DHH students is an international pattern, and as Swanwick et al report, more than 90% of DHH students are educated in mainstream environments in Britain (Swanwick, Gregory, Daunt, Hanifin, & Silo, 2007, p. 5). Berndsen and Luckner place this figure at 87% for the United States (Berndsen & Luckner, 2012). Some common examples of contextual barriers for DHH students are noisy settings, visual stimulus, the pace of classroom activities, poor acoustic environments, multiple speakers in discussion, as mentioned by Berndsen and Luckner (Berndsen & Luckner, 2012). Within the New Zealand context, the increased presence of modern learning environments may pose particular barriers for DHH students.

Self-Efficacy

Self-Efficacy refers to belief in oneself to accomplish tasks, and impacts how individuals approach goals and their determination when dealing with obstacles and experiencing challenging situations (Bandura, 1982) (Bandura, 1985). Self-efficacy can be an area of delay in DHH students due to its correlation with delayed language acquisition and executive function. As Marschark et al report in their study of the relationship between self-efficacy, communication skills and 'social maturity' of cochlear-implant wearers, one prominent factor that can predict higher levels in this area is parental influence and parental self-efficacy (Marschark, Walton, Crowe, Borgna, & Kronenberger, 2018). This appears reiterated in the work of Luckner and Muir in their investigation of the successful strategies employed by DHH students, with one of the key contributors to success being the impact of positive family relationships (Luckner & Muir, 2001).

Self-Determination

Self-Determination Theory arose as a connected research area and one highly mentioned in the literature surrounding Deaf and Hard of Hearing student success. For example, Luckner and Seabold's work regarding DHH student success lists student self-determination being a key contributor to successful outcomes (Luckner & Sebald, 2013). Self Determination describes a theory of human motivation that concerns the 'innate human needs' of competence, relatedness and autonomy (Deci & Ryan, 2008; Ryan & Deci, 2000). Field et al describe Self-determination as a synthesis of knowledge, beliefs and competencies that allows an individual to self-regulate and approach goals (Field, Council for Exceptional Children. Division on Career, & Transition, 1998) . Izzo and Lamb further describe the relationship between SDT and self-advocacy as: "Self-determined people know what they want and use their self-advocacy skills to get it" (Izzo & Lamb, 2002).

Self-Advocacy

Self-advocacy is one's ability to articulate and advocate for one's needs. Izzo and Lamb provide a definition of self-advocacy as: "the ability to assertively state wants, needs and rights, determine and pursue needed supports, and conduct your own affairs" (Izzo & Lamb, 2002). Schoffstall et al report that a large number of DHH students may be lacking self-advocacy skills, and recommend developing these skills by targeting particular advocacy areas. In their grounded theory study regarding DHH young adults they identified 16 themes relating to self-advocacy development, which included: identification of the necessary skills; linguistic skill building; communication access; full understanding; assessments; modelling strategies; confidence; and employer education, among others (Schoffstall, Cawthon, Tarantolo-

Leppo, & Wendel, 2015). Given an educational paradigm for DHH students that is increasingly mainstream-oriented it is necessary to examine how effectively students are able to advocate for themselves and their learning needs, particularly where access to specialists may be limited. Michael and Zidan studied the differences in self-advocacy behaviours between mainstreamed hard of hearing and hearing students and found that language and pragmatic factors contributed to students' ability to effectively engage in self-advocacy behaviours (Michael & Zidan, 2018). When looking at the factors contributing to academic progress of DHH students, Reed et al reported that self-advocacy was amongst the significant contributors to students who were succeeding academically, though this was in addition to other aforementioned factors such as high family and school expectations and the nature of communication between specialists working with the students (Reed, Antia, & Kreimeyer, 2008). Powell describes self-advocacy skills as being necessary skills to ensure a successful transition for DHH students from mainstream schooling to tertiary education (Powell, 2011, p. 27).

Theory of Mind

Theory of mind is the ability to attribute mental states to others and to recognize that someone else's knowledge may be different to your own (Frith & Frith, 2005). Theory of Mind was identified as important for the research enquiry based on SME suggestions that this was highly relevant to DHH student's development. The literature revealed that DHH students typically experience a delay in skills associated to theory of mind development, for example Jones et al found that DHH students experienced delays in these skills (Jones, Gutierrez, & Ludlow, 2015). The delay in theory of mind of deaf students can be similar to that experienced by students with

ASDs, as Peterson and Siegal found in their research which compared theory of mind delay in Autistic, Deaf and Normal Hearing children (Peterson & Siegal, 1999). The authors concluded that a lack of early dialogue about the mental states of others could be responsible for the delay of theory of mind skills in deaf as well as autistic children. This is especially relevant to deaf students who are born to hearing parents who may not communicate in sign language or actively discuss other's mental states with their children (ibid).

Executive Function

Executive function describes cognition relating to behavioural control e.g. to carry out and monitor ones behaviour to achieve a predefined goal. The development of executive function can be delayed in DHH students as a consequence of associated language delays. With delays in language acquisition, the DHH individual may not have the necessary language skills that aid executive functioning. Figueras et al suggest that executive function deficits or delays can contribute to poor organization, difficulty with instructions and turn taking within social interactions (Figueras, Edwards, & Langdon, 2008). The authors recommend prioritizing visual communication and 'self talk' as a means to improve students executive function skills (ibid).

Stigma and Social Isolation

Stigma was determined an important research area and work investigating the experience of deaf students indicates that social isolation and stigma is rampant for Deaf and Hard of Hearing students, as reported by Powell & Hyde (Powell & Hyde, 2014). Powell mentions the work of Fitzgerald & Associates, who found that the

mainstream education context often does not adequately accommodate the DHH learner. Powell & Hyde further describe recommendations made by Fitzgerald & Associates for more visual learning materials, accommodations and social skills resources for DHH students: *"*The researchers made other recommendations including the need for programs to deal with students' social needs through counselling, self-esteem, and social skills training*"* (Fitzgerald & Associates, 2000; Powell & Hyde, 2014). Experience of stigma and social isolation places DHH students at risk for lower self-esteem and likely reduces opportunities for social learning further due to fewer interaction opportunities. Hence, one of the aims of the research was to examine the perspective of educators and parents regarding stigma, and what they felt might help.

Design Framework

In order to determine the best way to proceed with the research, a search of the literature regarding design frameworks and methods was undertaken. Key principles that resulted from this are outlined in the following sections. The Goal-Directed framework was determined to be the most suited for the research and is based on the work of Cooper (Cooper, 2014). Supporting this were methods informed by Human centered Design (HCD) and User-Centered Design (UCD) frameworks. HCD and UCD are typically used to describe design research frameworks and philosophies where the user is placed at the centre of the research enquiry. However, the practical strategies within each framework can be unclear, with UCD variously described as usability-focused in some contexts (Stoker, 1983), and others referring to UCD as a more individual-centric approach to design activities. Giacomin describes HCD

design processes as being more qualitative in nature and portrays the process as '*seeking to identify the meaning which the product, system or service should offer to people*' (Giacomin, 2014). Given the perceived variability of the terms and the methods employed, the methodology described by 'Goal Directed Design' in Cooper's About Face was most appropriate for the research effort (Cooper, 2014). This approach is further complemented by Norman's work on emotional design, which is utilized in the persona mapping stage by a consideration of users 'visceral, behavioural and reflective tendencies' (Norman, 2004).

Co-Design and Participatory Design

Co-Design is a process where the role of the designer becomes more akin to the role of a facilitator, helping guide others through the process of design creation. The co-design principles which underpinned the project are described below and are partially discussed in the author's conference paper presented at ICDVRAT (Platt-Young, Shahri, Hector, Sutherland, & Hoermann, 2018). Co-design principles included active involvement of the groups the intervention is being developed for, iteration and feedback cycles where insights from co-designers are collected as the research progresses, and the designer as facilitator and co-creator rather than the solo designer with the sole authority for the design effort. Stakeholders were considered advocates for the proposed primary users based on their close exposure and knowledge of these individuals and their domain expertise. (Giacomin, 2014) Educators, parents and specialists were deemed to be SMEs in this domain area and contributed to co-design activities. Domain experts were also included as evaluators of design artefacts developed by the author.

GAME-BASED LEARNING

This area of research involved investigating the existing work on games as a form of intervention or education. The development of serious games, advice regarding serious games for education and ensuing user experience and game design ideas are discussed. The section is divided into the following areas: serious games and game-based learning , and consolidation games developed for use by educators.

Serious Games and Game-Based Learning

The literature was reviewed to determine motivating features of games and possible mechanics that might be suitable for incorporation into the proposed intervention. McGonigal's work on game elements was studied, with the main learnings concerning essential features of games (McGonigal, 2011). Universal features of games that were discussed by the author to be successful were the following: goals, rules, feedback systems and voluntary participation (McGonigal, 2011, p. 21). Clear articulation of game goals and feedback systems to encourage perseverance and engagement would likely need to be well considered for DHH students. In their work on the features of games and the debate around gamification and game design, Deterding et al propose the term 'gameful design' to describe approaches where successful elements of games are applied to non-game contexts in a meaningful way (Deterding, Dixon, Khaled, & Nacke, 2011). It is their framework that the author considers in the investigation of possible game elements. Motivational affordances of games are described by Deterding as important considerations when seeking to create a satisfying gameplay experience (Deterding, 2011). By this the author explains that game designers and educators run into trouble when gamification principles are applied to a learning objective in an ad-hoc fashion, without

consideration of which game principles lead to engagement. For example, extrinsic rewards such as leaderboards may impact the 'autonomy' a player could experience as they then place a visible consequence of not participating or playing, which destabilizes the 'leisurely play' component critical in the success of games.

Ryan and Rigby further define the following 'needs satisfying' areas as crucial for game-based learning projects to succeed: Competence; Autonomy; and Relatedness (Ryan R. M & Rigby C. S., (in press)). Competence refers to creating a challenge appropriately difficult for the player; providing informational feedback; having clear missions; and chances to repeat if an action or level is unsuccessful (ibid). Autonomy refers to fostering a sense that the player can make choices that will have an impact on gameplay and interaction, opportunities to customize or personalize the gameplay experience, and the freedom to explore or determine how to approach a task. Relatedness refers to a sense of connection with others, which the authors suggest is increasingly present in games that have strong social integration features such as Minecraft (Microsoft, 2018a) and which they suggest could be implemented through things like chat features within games. The argument put forth by the authors is that for game-based learning projects to succeed factors that increase intrinsic motivation should be cultivated and extrinsic factors like external rewards sparingly used (ibid). This ties in with work on self-determination theory (SDT), which posits that for sustained long-term engagement, internal rewards must be gained rather than external pressure placed on the learner. Malone offers advice to game designers of educational games by providing principles for game-based learning (Malone, 1980). These variously include the type of goals, performance feedback, variable difficulty levels, hidden information and randomness, among others. Purely informational goals, such as percent scored in an arithmetic game are not particularly compelling, Malone

argues, because they do not have a clear and interesting goal, like ‘fly a rocket to the moon’ (Malone, 1980). As mentioned in ‘Reality is Broken’, players are often drawn to games for their goals and narratives. Focusing too much on external rewards can be detrimental to sustained game play (McGonigal, 2011). Recent projects in the area of games and applications for therapy and mentoring purposes of DHH students are “League of Hearoes” a Minecraft environment created for d/Deaf students and “My World”, an application developed by Ida Institute as a counseling tool for DHH students and counselors (Delaney, 2018) (Microsoft, 2018a) (Ida Institute, 2018). Though these tools might benefit DHH students by offering a safe communication medium to talk about their experience with others, their focus is not primarily on developing student’s skills in the pragmatics areas targeted.

De Lope et al describe a framework for educational games that is broken down into the design of acts, scenarios and scenes (De Lope, Medina-Medina, Montes Soldado, Mora Garcia, & Gutierrez-Vela). They suggest that by using this framework, game designers can determine the overall theme, then the goals or situations that may fall within the wider theme, and the mini-scenarios that occur within this. Such a framework appeared useful for the intervention design effort given the expectation that context barriers could inform ‘scenario inspiration’ for the scenarios to occur with a game-based intervention. For example, SMEs had mentioned the possibility that ‘sports’ could be interesting to explore in an invention and based on De Lope et al’s framework, scenes within this could be the connected micro-interactions that occur within the context of ‘sports’ and fall under the category or theme of ‘team activities’.

Consolidation and Educational Games

A search was undertaken to understand strategies educators and resource specialists in the space might currently be using and the associated learnings useful for the research area. Some approaches developed by Noll centre around teacher adaptation of games and play activities to augment for further communication opportunities and modelling opportunities (Noll, 2007). The consolidation games proposed by Noll primarily focus on emotion recognition, receptive language skills, conflict resolution, asking for help, self-control, initiating interactions and social cue recognition (Noll, 2007), and hence describe several areas potentially relevant to the proposed intervention.

SYSTEMATIC LITERATURE REVIEW

Following a process of SME consultation and informal observation, the aforementioned areas of pragmatics described in the 'social skills and pragmatics' section of this chapter emerged as important for research consideration. These were self-efficacy, self-advocacy, stigma, contextual barriers and conversational repair strategies. Peripheral areas of interest included Theory of Mind and Executive Function. The Prospero internal prospective register for systematic review was searched to determine if there were registered literature reviews that focused on technology-based social skills interventions for DHH students. Upon discovering no reviews with a similar aim of technology-based social skills interventions for DHH students existed, a Prospero protocol was developed by the author and another researcher (Platt-Young & Hoermann, 2018). Based on the dearth of literature regarding technology-based interventions for Deaf and Hard of Hearing students discovered in the preliminary searches, the literature review search criteria was extended to include ASD interventions. In summary, the Prospero protocol had the

following search criteria; digital social skills interventions where the primary targeted participants for the intervention were DHH students or students on the Autism Spectrum. In order for papers to meet the inclusion criteria they had to describe a digital intervention that had a significant focus on social skills or communication strategies, and involve or be produced for DHH students. The inclusion criteria also contained studies that were produced for students with ASD if they targeted an outcome where DHH students have deficits, for example empathy, social and emotional development or confidence in novel situations (Korte, Potter, & Nielsen, 2014). All papers in order to be included had to describe an evaluation with representative users. Seven scientific databases were searched. The final search protocol was accepted and can be found in the Prospero database with registration number (CRD42018092708) and in the Appendix of this thesis.

The initial search returned 854 papers, and after duplicate removal and initial screening 794 remained. The titles of the remaining 794 papers were then skimmed to remove papers that were obviously outside to the scope of the systematic review. Following this step 94 papers remained. Full text articles were then sourced and manuscripts for 93 of the 94 papers could be obtained. One manuscript, despite several requests to the authors, could not be attained. All manuscript files and their metadata were then uploaded into a covidence review system (www.covidence.org) for screening by a team of four researchers including the author. The researchers formed teams of two and reviewed the abstracts of the selected papers independently for their alignment with the search criteria, with reviewers marking a paper “yes”, “no” or “maybe”. Conflicts in the selection were resolved by involving a third researcher. Following this process 47 papers remained for full text screening. In the subsequent round, the full text of all articles was reviewed and marked as included or

excluded by two researchers independently. Conflicts were resolved through discussion and considering the notes provided by the reviewers. The 17 articles remaining from this final screening were then examined to extract the type of intervention, the participants of the intervention, and the target area of pragmatics, for example scenario-based pre-teaching using mobile applications. The 17 papers remaining papers met the inclusion criteria and described a study of a technology-based intervention for an area of social skills with students between the ages of 6-21 years old. However, none of the studies meeting inclusion criteria described an intervention for d/Deaf and Hard of Hearing students.

The obvious paucity in the research regarding interventions for DHH students thus reinforced the author's original instinct during the optimization of the search strategy to include interventions targeting students with ASD in the inclusion criteria. This intuition was justified by further research of the literature regarding similarities between presentation of social skills in ASD and DHH groups and by the authors of one of the papers that met grounds for inclusion. The work of Cole et al. describes a perceptive computer animated virtual system "Talking Head" which they evaluated with children with hearing impairments in addition to children with ASD (Cole et al., 2003). Despite the limited capabilities of the virtual avatar compared to current technology systems, the authors were still able to show learning gains in both groups. For example, students with ASD showed improved classroom behaviour as a result of using the intervention, whereas profoundly deaf students made dramatic improvements in their speech perception and production (pp. 1394-1395).

CHAPTER 3: METHODS

This chapter describes the methods employed in the study. The research utilized a goal-directed design framework and methods from human centered design in combination with methods borrowed from grounded theory (Birks & Mills, 2015). These methods were employed to elicit key user considerations from those working with Deaf and Hard of Hearing students. The chapter then describes the selection of appropriate primary data collection methods, qualitative methods, respondent selection, focus groups, interviews and workshops, co design and ideation methods, data collection and handling, thematic content analysis, relevant grounded theory methods, theme generation, synthesis and design.

SCOPING AND SME CONSULTATION

Prior to the main research effort, informal conversations with subject matter experts were ongoing around the possible areas of importance for an intervention for Deaf and Hard of Hearing students. Informal observations and conversations allowed for areas of research questioning to be defined, and these research questions were further refined by the existing literature in the area of social pragmatics, for example in the areas of self advocacy, efficacy, stigma, contextual barriers and conversational repair strategies. Additionally, user experience considerations in the areas of media, interface, language and reading levels, technology access, communication modalities and student preferences were identified as being key areas to inform the research enquiry.

Design Framework

Due to the paucity of the research concerning digital social skills interventions for Deaf and Hard of Hearing children and youth, a goal-directed design framework in combination with grounded theory methods was determined to be the most suitable approach to uncovering user experience considerations for DHH students, and for the design of user experience concepts and recommendations. This framework was largely inspired by Cooper's, About Face (Cooper, 2014). Goal directed processes, and key tools including personas and scenarios informed the collection of qualitative data and inspired the ideation and co-design sessions conducted with stakeholders.

The thesis project also follows the philosophy of human-centered design, where "users are at the centre of the design process" (Putnam et al., 2016) . However, the design methods employed are informed by Cooper's Goal-Directed method because of their focus on observed patterns, such as a focus on understanding user's goals and motivations and mapping this to possible interaction design. Given the challenges of formally including Deaf and Hard of Hearing students in the process, and the high probability that educators and parents would be the secondary users of the proposed intervention, educator and parents were identified as the required participants for interviews and as co-designers in focus groups. Throughout the project a philosophy of consultation and co-design was followed, with an emphasis on the Gould and Lewis principles of early focus on the user and iteration informed by data from users (ibid; (Gould & Lewis, 1985)). Their empirical measurement principle was more difficult to apply in the research, as the intervention was not at a state where usability testing of the system was possible – indeed, the aim of the thesis research was to identify key elements for the design, user experience and iteration of such an intervention. Despite this, informal observations and consultations with users and

subject matter experts took place at schools and in the community. These consultations revealed SMEs' belief that such an intervention was necessary and teachers explained the importance of strategies such as review, sensory reinforcement and total communication for augmenting students' learning. Classroom observation illustrated that Teachers of the Deaf were using a number of tactile and visual learning aids to facilitate learning and that games were available for students to play in the classroom.

Educators and parents participated in interviews and focus groups that focused on the aforementioned pragmatics areas in addition to technology, games and user experience questions, as well as questions relating to identity and culture. The aim was to unearth educators and parents current experience of learning strategies, games and digital tools to see if there were patterns that could be observed in gameplay and user behaviour, and in which areas social learning areas their children or students might be better enabled. A variety of responses were collected for these research areas though interviews and focus groups, as well as during ideation activities in focus group sessions. Grounded theory methods informed the iterative nature of the data collection in interviews and focus groups, with the interview script open to follow-up questions to allow for further investigation of novel concepts as the research progressed. The structure and implementation of qualitative methods are discussed in the following sections.

Qualitative Framework: Grounded Theory Methods

Methods from Grounded Theory were utilized to direct collection and analysis of primary data and determination of themes relevant to the design of the intervention (Corbin & Strauss, 2008). Grounded theory is a research framework developed by Glaser and Strauss in an effort to provide research rigour and confidence for qualitative research, and which bridged the gap between theory and method (Glaser, 2016) (Glaser, Strauss, & Strutzel, 1968). The grounded theory methods adopted by the author included; semi structured interviews; thematic content analysis; data coding, memoing, constant comparison and theme generation following saturation (Silverman, 2009) (Edmonds & Kennedy, 2013a). Grounded theory methods were selected due to the nature of the data to be collected, and allowed for respondents' varying responses to be coded into meta-categories that described areas of prominence for the intervention design effort. Grounded theory was determined as the most appropriate framework given the 'limited prior information' available regarding the research area (ibid). Such a framework was suited to uncovering diverse themes from multiple respondents and refining these into key categories for intervention consideration. Given the sparse recommendations in the area of game-based interventions for social skill augmentation of DHH students, an open discovery framework was desirable to explore emergent ideas further as the research progressed.

Ethics

Ethics approval was approved for the research by the University of Canterbury Educational Research Human Ethics Committee. Information sheets and consent forms were sent either by email or given in hardcopy to each interviewee and focus group participant explaining the purpose of the study and what their participation would entail. Interview and focus group respondents were informed that their identity would be kept confidential by use of pseudonyms. In the case of focus group respondents, the nature of the questioning meant that the conversation could not be completely confidential due to the group format of the session, with participants being offered the chance to review a summary of the focus group rather than a transcript as a measure to protect the confidentiality of the other participants. Participants were also made aware of their right to withdraw from the study up until the point of data analysis, apart from in the case of focus group respondents whose data could not be removed due to its impact on the group discussion. Ethics documentation can be found in the Appendix.

Recruitment

Recruitment of educator respondents was achieved by establishing contact with a Deaf education centre and providing detail and information sheets about the project. Educators were invited to contact the author directly if they were interested in participating in either interviews or focus groups. Parent respondents were identified by liaising with a subject matter expert who advertised the project in online channels such as social media, with parent respondents contacting the research team via email to express their interest in participating in the research. Recruitment posters

promoting the project were also displayed in audiology clinics, at the University of Canterbury and distributed via email.

Respondents

Because the primary users of the intervention were identified as DHH children and youth, parents and educators working with DHH students were determined to be knowledgeable informants who could contribute valuable insights and domain expertise for the design process. Interviews and Focus Groups were conducted with Resource Teachers of the Deaf; Teachers of the Deaf; Mainstream Educators; Speech Language Therapists; Audiologists; NZSL Tutors; Transition teachers; and Parents of DHH students. There were 17 respondents in total, with three parent respondents and 14 educator and specialist respondents. Interviewees numbered seven and there were 10 focus group participants in addition to five participants in a pilot focus group.

Respondent Characteristics by Cohort

Parents	**Educators and Specialists**
3	14
Total: 17	

Figure 1: Respondent Characteristics by Cohort

Respondent Characteristics by Research Method Employed

Interview Respondents	**Focus Group Respondents**
7	10
Total: 17	

Figure 2: Respondent Characteristics by Research Method

Note regarding focus group participants:

- Resource Teachers of the Deaf work closely with Deaf students, and most often have a case load of between 4-5 students (Ministry Of Education, 2018).
- Teachers of the Deaf typically work in classrooms of DHH students, and in the case of this project, were based in a satellite unit of two classrooms for the Deaf inside a wider mainstream primary school.
- Transition Teacher: primary role is to prepare and ease the transition of the DHH student from the high school environment to life outside, for example to employment or tertiary education.

PARTICIPANTS OF THE FOCUS GROUPS

Pilot Focus Group	Focus Group One	Focus Group Two	Focus Group Three
5 respondents (postgraduate students)	3 Resource Teachers of the Deaf (all female)	2 Teachers of the Deaf (all female)	5 specialists working in various roles with DHH students
Purpose of the pilot focus group was to test and refine the question script, the materials, timing and follow-up prompts.	1 Senior Resource Teacher of the Deaf (female, Deaf), 1 Resource Teacher of the Deaf (female, Deaf), 1 Resource Teacher of the Deaf (female, hearing)	1 Senior Teacher of the Deaf (female, Hearing), 1 Teacher of the Deaf (female, Hearing)	1 NZSL tutor (male, Deaf), 1 Audiologist (male, hearing), 1 Speech Language Therapist (female, hearing), 1 Transition Lead (female, hearing) 1 Cultural Liaison* (female, hearing)
5 Respondents	3 Respondents	2 Respondents	5 Respondents

Figure 3: Focus Group Respondents

SEMI-STRUCTURED INTERVIEWS

Semi-structured interviews were selected as a primary research method, given the potential for open-ended responses and the perceived variability in respondent's experiences. They are also recommended by Cooper as an established method to gain user insight (Cooper, 2014), and are a common tool within Grounded Theory. As

Adams and Cox explain, the use of a semi-structured interview format is well suited to situations where the researcher wants to "maximise the information obtained" by deviating from pre-established questions where the opportunity to collect rich data is presented (Adams & Cox, 2008, pp. 21-22).

Interviews were conducted via remote video call interviews with parents and educators, where respondents could participate from the comfort of their own homes or offices. Lists of question topics were prepared for the interviews, and questions varied between the general and the specific to encourage respondents to share their experiences. Given the variety of the respondent cohort these were "sufficiently general to cover a wide range of experiences and narrow enough to elicit and explore the participant's specific experience" (Gubrium, 2012, p. 351). The researcher's follow-up questions were driven by the respondent's comments as the conversation played out between interviewer and interviewee (Edmonds & Kennedy, 2013b). These interviews typically lasted a duration of 30-60 minutes. Both interviews and focus groups were conducted. The perceived advantages of interviews over focus groups are that respondents may share more personal perspectives that they may otherwise refrain from sharing within a group dynamic. There is also less likelihood of group bias.

Interview topics comprised three general areas of perceived importance to the enquiry; Social skills, Pragmatics and Social Communication; Games and Interface Technology; and Identity, Culture and Relationships. The questions relating to these were refined following a test interview with a subject matter expert who had close connections to the Deaf community, and repetitive, lengthy or unclear questions were rephrased and re-written for improved clarity. Prior to each interview, the purpose of the study and a brief outline of the interview and explanation regarding recording of

the interview was given to each respondent. Interviewees were also invited to interrupt at any stage if they did not understand what had been asked, or if they wished the interviewer to clarify or repeat what had been asked. This was especially important given the remote context of the interviews, with internet lag and microphone issues creating possible confusion. After the interview had been conducted, the researcher asked respondents for their feedback regarding how to improve for future interviews in an effort to improve the experience for subsequent respondents. Interviews were conducted primarily using Skype and recorded using an MP3 recording application that recorded both interviewee and interviewer. Audio was then transcribed with pseudonyms replacing sensitive information.

Focus Groups

Focus groups were conducted with groups of educators, with three separate sessions taking place. Though the location of each of the focus groups varied, the set-up was comprised of a table and chairs, ideation prompts printed on A3 paper that were developed by the author (see appendix), post-it notes that differed in colour for each participant and markers. Recording equipment included a speakerphone system that was connected to a laptop and recorded MP3 audio. Photographs were taken of the artefacts produced during each session, for example participant's post-it notes as placed on the ideation prompts within the session. The author was positioned around the circle with the focus group participants to establish rapport and following suggestions of pilot focus group participants that this had made them feel more at ease. A research assistant helped with documenting and recording the session, which

allowed the author to focus on asking follow-up questions and establish lines of enquiry.

The focus groups included Resource Teachers of the Deaf, Teachers of the Deaf and the third focus group had a diverse mix of respondents, with educators and resource specialists in different roles. Focus groups were divided into two main sections; a reflective open questioning time which included questions similar to those of the semi-structured interviews, and an active ideation component where participants were presented with tasks to generate ideas, concepts or answers. The group format provided an opportunity where other participants could comment on fellow participant's answers, and included an ideation section, where participants were allocated colour-coded post-its and asked to write down their ideas in response to question prompts placed on resources developed by the author. Focus groups were conducted with educators rather than parents due to the perceived personal nature of the questioning and possibility that parents would feel more comfortable in one-on-one environments with the researcher, rather than discussing their child and their experiences in a group format, especially given the potential for discussions regarding stigma.

The focus groups ranged in length from 90 minutes to 150 minutes and were comprised of between two and five participants (not including the research team and NZSL interpreters). The number of participants was lower than accepted wisdom regarding focus groups, for example as found in (Krueger & Casey, 2015, p. 35), which recommends 5-10 participants. A pilot focus group ran beyond 120 minutes, leading the author to re-examine the maximum number of participants required for effective data collection and discussion. Focus Group 1 had three Resource Teachers of the Deaf and took place in a meeting room in a public restaurant. Focus Group Two

was held with two Teachers of the Deaf in the meeting room of the school both respondents were employed at. The final focus group was conducted onsite at a Deaf education centre with five participants and two NZSL interpreters. The author recommends adapting the focus group format when running sessions with similar respondents, as including DHH participants may require additional set-up time as well as longer time to relay messages between interpreters, the DHH participant, and those who do not communicate with NZSL.

Reflective Group Questioning

The reflective segment of the focus groups focused primarily on respondent's own experiences, knowledge and opinions regarding various social and communication challenges faced by DHH students. Questions were adapted from the list of questions prepared for remote interviews to allow for the group setting. The flow of these questions was tested in a pilot session, however due to the loose structure of conversation these were not necessarily in the same order, with some follow-up questions occurring later in the conversation. See the Appendix for the list of questions developed for these sessions.

Co-Design Ideation Activities

Co-Design took the form of an ideation segment in the second half of the focus groups, where educator participants actively conceptualized possible solutions, concepts and ideas related to the main research questions. Co-design activities were implemented by including domain specialists in the ideation of concepts and ideas (Sanders & Stappers, 2008) regarding areas of importance for the proposed intervention. Artefacts were designed by the author to elicit active feedback and

participation of participants, a process which Sanders et al define as '*the researcher supports the 'expert of his/her experience*' by providing tools for ideation and expression (ibid). The design of the ideation materials was largely inspired by the work of IDEO in this space (IDEO, 2015). Ideation questions were tested with a pilot focus group of participants to refine content. Two of these participants had experience as educators though did not have a substantial amount of experience with DHH students. However, the experience was worthwhile to determine the timing and content of the sessions and pilot participants were asked for their feedback regarding what they felt worked and what could be improved before running sessions with parents and educators of DHH students. Areas of duplication, for example where ideation questions overlapped with the interview script were removed and questions and ideation artefacts reconfigured to optimize the sessions. Issues of facilitation and the structure of the session were improved following this exercise, and the author heartily recommends running a pilot session to other researchers, especially in instances where they might be dealing with a large deal of qualitative data and co-design methods.

Within the focus groups, question prompts on large sheets of paper were prepared for data collection, and participants were invited to choose a post-it note colour for their responses. This had multiple benefits, as it allowed the participants in the group to track their own ideas and concepts, and allowed for discussion, thus providing the researcher with rich insight into the perspectives of multiple members of the group and where ideas might be convergent or divergent.

Q1:	*What hobbies do your students enjoy? How could these be used for additional learning?*
Q2:	*What would a game/tool for social communication skills need to have, to meet the needs of DHH students?*
Q3:	*What would it need to have to be fun or enjoyable to use/play?*
Q4:	*Frustrating situation – what would the response be? What might help or hurt?*
Q5:	*Media requirements for the game/app? What would it need to have and why?*
Q6:	*Scenarios – what scenes, situations or places would be helpful to include in the game?*
Q7:	*What would success for your DHH students look like?*
Q8:	*What resources exist already? What would you change or keep the same?*
Q9:	*In an ideal world, what could the game/tool be or do?*
Q10:	*What elements of Deaf culture would you like to see included in digital tools?*

Table 1: Ideation Questions

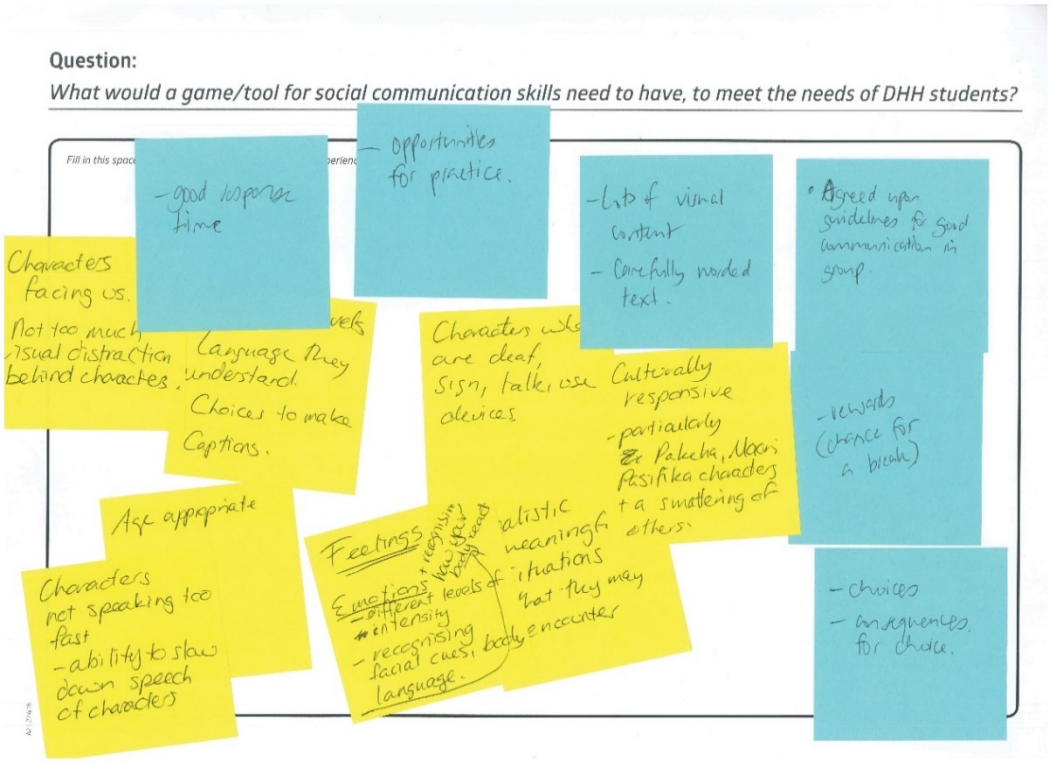


Figure 4: Ideation Responses on Prompt Sheet

Pictured: *Example of responses from ideation activity prepared for focus groups. These were designed to elicit participant feedback without respondent's 'pre-judging' their ideas.*

To limit the effects of group-bias, participants were encouraged to quickly write down their ideas on their respective post-it notes without pre-judging their ideas, with the occasional follow-up question. For example, "*in terms of this pink post-it labelled "VR" – do you have something in particular in mind?*" This further allowed the researcher to establish a shared understanding with the respondents, thereby limiting the assumptions possibly drawn in regards to the concepts listed on the post-it notes. Such follow-up questions allowed other members of the group to consider if they had perspectives to offer in connection to the concept under discussion. See the Appendix for the complete Ideation materials.

PERSONAS

Personas are conceptual user archetypes based on a combination of patterns and characteristics from the collected primary and secondary data that describe a possible user. They depict likely motivations, contextual and environmental information, values and goals. Turner et al describe the purpose of personas as '*... to create shared understanding between the design team and the proposed users of the design output'.* (Turner, Reeder, & Ramey, 2013). Personas are used as a tool to aid and define the system under development and to ensure the design effort remains user-centered. Personas were based on the key themes emergent in the analysed data and further evaluated in a remote workshop with a subject matter expert, a speech-language therapist who had experience working closely with d/Deaf and Hard of Hearing students.

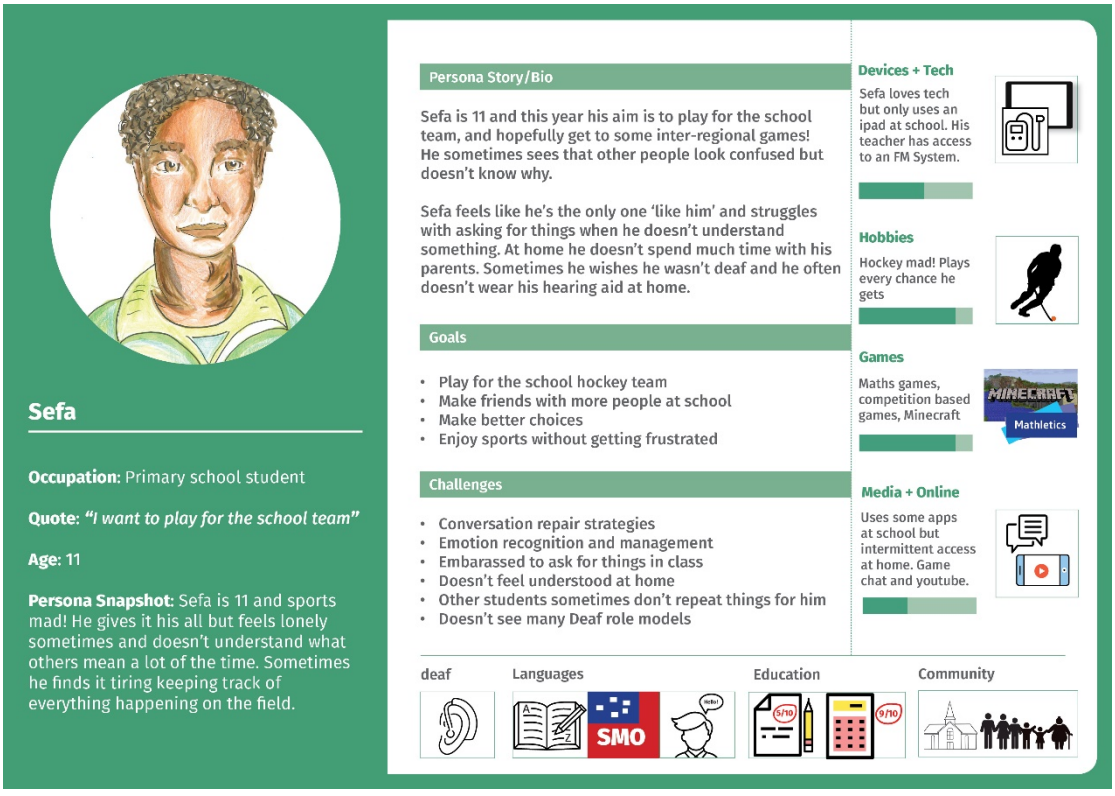


Figure 5:Example of a persona developed by the author based on collected data.

Context Scenarios

Scenarios focus on how the persona interacts with their environment and may describe a day in the life of the persona – and the actions, interactions and events that may arise. Scenarios in their classic conceptualization by Cooper describe a user's high level interaction with the system, with descriptions of the persona's interactions, objects, actions and context (ibid) (Cooper, 2014). The aim is to understand the persona and communicate areas where the system might be able to support the persona in their life or a particular context.

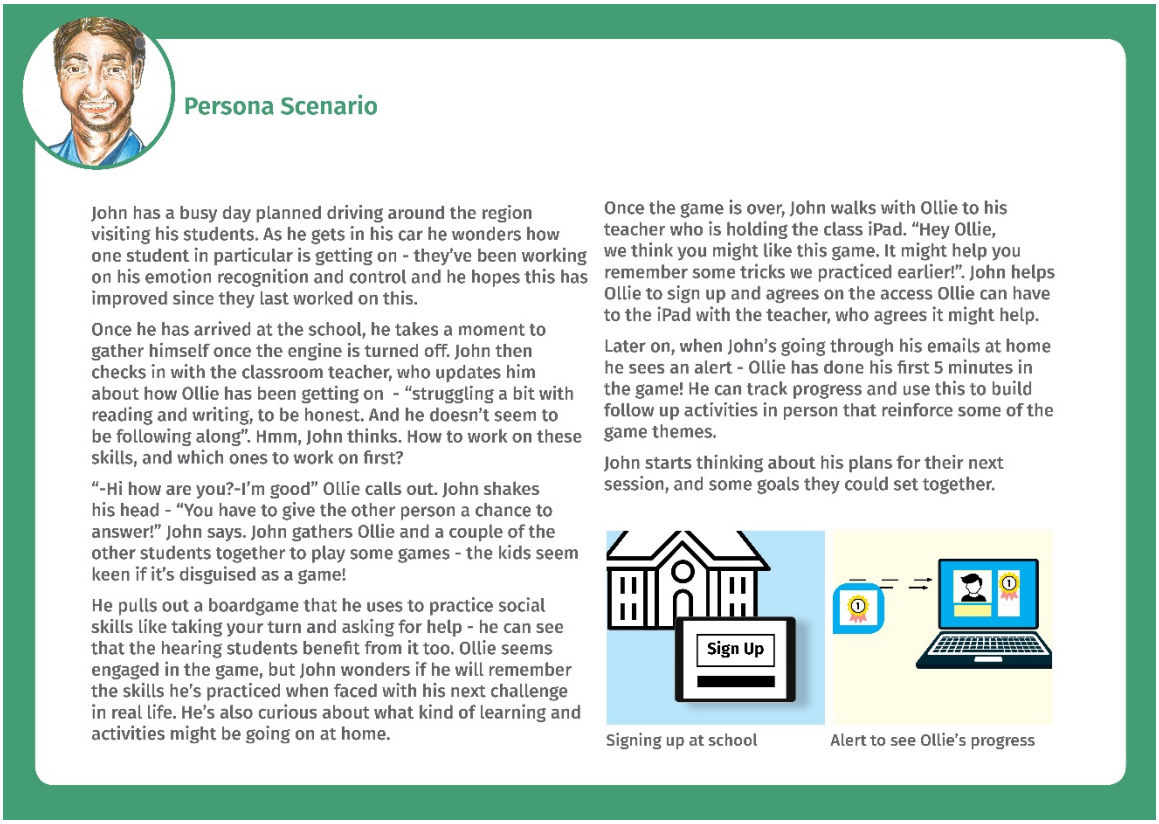


Figure 6: Example of a Context Scenario

Scenarios – Game

Codes that developed from interview transcript data were used to highlight the important themes for inclusion in future game intervention scenarios. These scenarios are conceptual situations informed by common areas of social skill deficit as described by educators and parents within interviews and focus groups. Scenarios are conceptualized by De Lope et al as "*a 2D or 3D space where scenes take place (and these scenes) are designed by deciding which conditions must be met in order to move from one scenario to another. It is complemented with an informal description of every scenario and the interactive objects present in it*". (De Lope et al.) In their framework for the design of educational games, Scenarios map to Acts, which in their example is Rome, and the Scenario of "Country Estate" includes the scene "repair chariot", which is a success criteria that needs to be met in order for the player to proceed on to the next scene and progress through the game (ibid). Elements of this framework have been employed in this project, specifically that of recommendations for in-game scenarios. For example, one scenario could be "sports" which contains the scene "ask for help during a hockey game", and which is targeted at one of the design personas. Game scenarios are presented as recommendations for the future intervention design effort (see user experience and design recommendations chapter).

Recording and Transcription

Audio data from remote interviews and photographic and audio data was collected in focus groups. Audio data was then transcribed, with a selection of the transcripts being shared with another researcher to independently code the text, in an effort to achieve inter-coder reliability and improve the robustness of the coding (Aldiabat & Le Navenec, 2018). Participant responses from the ideation segment of the focus

groups were scanned and the text data entered into tables for each focus group respondent according to the question their post-it notes related to. These were then grouped per focus group and are also provided in Appendix A.

Ideation Questions	FG1 Yellow Post-Its	FG 1 Blue Post-Its
A1: *What hobbies do your students enjoy? How could these be used for additional learning?*	Superheroes: role playing, pictures linked to language needs eg body parts/ clothes; animals - link vocab; Lego (preschooler/primary), barrier games, postional language; Culture interests, culturally responsive books; Sports, deaf sports role models	Spy novels: write clues, following sequences, using interest to (sp?) ideas for writing, making resources related; Orienteering: listenting activities, giving directions, prepositions
A2: *What would a game/tool for social communication skills need to have, to meet the needs of DHH students?*	Characters facing us, not too much visual distraction behind characters; Different levels, Language they understand, choices to make, captions; Age appropriate; Characters not speaking too fast, ability to slow down speech of characters; Feelings, plus recognising how your body reacts, Emotions, different levels of intensity, recognising facial cues, body language (arrow to another post it) - Realistic meaningful situations that they may encounter; Characters who are deaf, sign, talk, use devices (post its seemed linke) - Culturally responsive, particularly Pakeha, Maori, Pacifca characters + a smattering of others.	Good response time; opportunities for practice; lots of visual content, carefully worded text; Agreed upon guidelines for good communication in group; rewards (chance for break); choices, consequences for choice

Figure 7: Ideation Table Example

Analysis: Interview Questions and Categories

The questions for remote interviews were generally attributable to three main areas; Social Skills, Communication and Pragmatics; Games and User Experience; and Identity, Culture and Relationships. Within these categories were sub-categories related to specific research areas such as Self-Efficacy. Games and User Experience contained subcategories related to things like game mechanics, games respondents' students or children played and related user experience considerations. Within Identity, Culture and Relationships, question categories included sub-categories around topics such as Deaf culture, societal inclusion and stigma.

NVivo Analysis and Coding

NVivo is a qualitative data analysis software (QDAS) program and was selected as a qualitative analysis tool due to the functionality within the software to organise vast amounts of qualitative data, electronically code transcript data to describe categories emerging from data and to query the data (NVivo, 2018). As Woods et al report in their content analysis of 763 articles utilising the QDAS software tools ATLAS.ti and NVivo, these tools are primarily used by qualitative researchers "for data management and analysis" (ATLAS.ti, 2018; NVivo, 2018; Woods, Paulus, Atkins, & Macklin, 2016). As Holton explains of the coding process: "coding is the core process in classic grounded theory methodology. It is through coding that the conceptual abstraction of data and its reintegration as theory takes place" (Holton, 2007, p. 265). The aim was however to establish research confidence that the 'grab' of the data was sufficient to describe the important themes for the future design of an intervention and the associated user experience concerns, rather than to 'reintegrate the data into a theory'. The researcher had possible codes in mind when data analysis began, due to the exposure to the data during the transcription process. However, an open coding approach was taken and descriptive codes created to explain the meaning behind passages of text occurring within the interview transcripts. Following the coding of the first interview approximately 40 codes (termed 'nodes' within the software), had been created to explain the concepts discussed by the respondent, a Resource Teacher of the Deaf. As subsequent interviews were conducted, new nodes were created within NVivo software to describe the data where new concepts emerged. The constant comparative method was used to frame the coding, with reflection occurring during the analysis process of coding the transcript by comparing the coded text with similar concepts arising from other interviews, and considering how these conformed

to the same category. Different dimensions of the same concept were included within a code, for example, “Societal Inclusion” also included examples from the transcript text that described instances where respondents discussed exclusion. The aim was to code the interviews and focus groups in an expansive manner, and then to narrow down the codes to their essential categories, describing a ‘basic social process’ that was relevant in addressing the research questions (Birks & Mills, 2015, p. 97; Glaser, 1978).

Grounded Theory Methods - Constant Comparison

The constant comparative process aims to develop a theory based on data qualitatively coded by the researcher. Though the author’s intention was not to develop an overall theory regarding the experience of respondents, this method was determined to help ascertain if data saturation conditions were being met. Transcripts with respondents’ identifying features removed were imported into NVivo software (NVivo, 2018). Transcripts were then coded into descriptive categories based on inductive principles. The author followed a constant comparison process, where descriptive codes were initially prepared from the text data, and then later reviewed and compared for similarity between respondents’ codes. Incidences of the data were then compared to their descriptive codes following the process described by Charmaz and cited in Savin-Badin & Major (Charmaz, 2005; Savin-Baden & Major, 2012, p. 437). These codes were further refined or combined following reflection and independent coding of a sample of the interview transcripts. This process created some combined meta-codes and sub-codes which were indicative of key themes or patterns in the data and which described the emergence of larger thematic rather than basic descriptive codes (Holton, 2007).

An example of this process from open descriptive coding towards theoretical coding and the ongoing comparison procedure is provided: ‘Gameplay’; ‘Game Mechanics’, and ‘Games and Digital Tools used by teacher’, were originally created as stand-alone codes, sometimes conforming to different categories. Upon review of the coding of subsequent interview transcripts, these codes were revised, categorized and placed under the general theme of ‘Games’. Memos were created during this process and transcripts and code lists shared with another researcher, to see where categorization and coding differed. The researcher also coded a hard copy of the transcript to establish thoughts related to the text, and then later coded the electronic version so that initial impressions regarding the nature of the data would not be lost. Approximately a third of the interview transcripts were shared with another researcher experienced in grounded theory methods, for purposes of checking the code categorization and accuracy in describing the concepts. Very few differences in coding existed between the author’s coding and the review coding, and where they did these were merged into new codes or the code was refined. Coding reference lists were created for each respondent, allowing for comparison between respondents, and to determine where a new code or dimension of a code appeared. This further allowed interview transcripts to be reviewed to determine if theoretical saturation was being approached.

Memos

Memos were used within NVivo as a method to track coding decisions, note down examples of themes from within the transcripts, and as a way to enhance the constant comparative process and data saturation conditions (Aldiabat & Le Navenec, 2018). Where an example or concept from the interview text might present as a borderline

case in terms of categorization, the author endeavoured to note these down, sometimes with an explanation as to how this could connect to similar concepts raised by other respondents. Memos additionally served as a review device when scanning code summary reports generated in NVivo and helped to define patterns and themes.

Data Saturation

Data Saturation was aimed for in the collection of data, and the methods that were followed to this end included memos; constant comparison of the incidents and categories; persistent observation; inter-coder reliability; member checking where possible; and triangulation of qualitative methods as outlined by Morse (Morse, 2015) and cited in (Aldiabat & Le Navenec, 2018). This was in an effort to make as explicit as possible those areas which were defined as being saturated (Bowen, 2008). The author examined codes within NVivo and highlighted those appearing frequently and by multiple respondents to further determine where saturation of themes might be occurring. A full code list of these themes is provided in the Appendix.

Ideation Activity

The answers from the ideation session of each focus group were entered into tables. For example, for the question "*what would the game need to have for Deaf Students?*" responses were organized per focus group and then compared with the responses from other focus groups. The key themes and areas of importance for the intervention were then identified for each question by investigating the particular nodes attributable to a particular category. For example, the node 'hockey' falling under the "sports" code in NVIVO and its relationship to "hobbies and interests" and "contextual barriers" could describe an emerging pattern of problematic interactions occurring during sports

events because of difficulties in hearing voices of teammates and the ensuing cognitive load required to visually track sports players. A respondent in Focus Group One, and another in Focus Group Three had to leave partway through the ideation session. In the case of Focus Group One, respondents were emailed the ideation questions for their comment. In Focus Group Three, the respondent left approximately halfway through the ideation segment, around Question 5. Therefore, the total number of focus group responses in the three sessions was 10, with full participation from eight.

Design Artefact Workshop with Subject Matter Expert

For purposes of establishing confidence that the themes identified by the author accurately described the collected primary data, triangulation was sought by presenting personas and scenarios to a speech language therapist who had a great deal of domain expertise. Triangulation is a process that seeks to improve the validity of the research by including a range of methods and means of checking the data (Morse, 2015). A remote workshop with a subject matter expert was conducted via Skype (Microsoft, 2018b) to achieve validation of the prepared personas and scenarios. The SME respondent was identified following the focus groups, and asked for their comments regarding the initial design artefacts. Given their specific domain expertise as a speech language therapist and knowledge of the likely users of the intervention, this step allowed for further validation that the research conclusions were valid, and if not how these artefacts and recommendations could be improved to reflect the needs of the user group. Insights from this workshop were summarized to inform the final personas, scenarios, recommendations and documentation.

CHAPTER 4: RESULTS

Findings are introduced and outlined in this chapter and are presented by theme. The findings from interviews and focus groups are presented and notes are made regarding the respondent characteristics. Ideation activity findings are presented at the end of the chapter. It is worth noting that all focus group respondents worked with students in a professional capacity in the education or specialist fields, and parents participated only in remote interviews. Findings are commented upon in depth within the discussion chapter.

INTERVIEW RESPONDENTS

I1	Resource Teacher of the Deaf (Deaf)
I2	Special Educational Needs Coordinator at a mainstream school, Deputy Principal. (Hearing)
I3	Parent of a seven year old deaf daughter (Hearing)
I4	Parent of young deaf sons (Hearing)
BN	Background noise within the interview with I4
I5	Early Childhood Teacher (Hearing)
I6	Teacher of the Deaf (Hearing)
I7	Parent of deaf teenage sons, TA (Hearing)
I712YR	12 year old son of I7 (not in interview, discussed by I7)
I715YR	15 year old son of I7 (not in interview, discussed by I7)

Table 2: Interview Respondent Pseudonyms

Focus Group Participants: Focus Group One	
Resource Teachers of the Deaf with a caseload of students or coordinating the efforts of resource teachers.	
FG1_R1	Resource Teacher of the Deaf (Deaf)
FG1_R2	Resource Teacher of the Deaf, Coordinator (Deaf)
FG1_R3	Resource Teacher of the Deaf (Deaf)

Table 3: Focus Group One Participants

Focus Group Participants: Focus Group Two	
Teachers of the Deaf in a satellite classroom for the Deaf in a mainstream school.	
FG2_R1	Teacher of the Deaf, Senior Teacher (Hearing)
FG2_R2	Teacher of the Deaf, Classroom Teacher (Hearing)

Table 4: Focus Group Participants: Focus Group Two

Focus Group Participants: Focus Group Three	
Educators and Specialists working with DHH students in a number of capacities.	
FG3_R1	Audiologist (Hearing)
FG3_R2	NZSL Tutor and Coordinator (profoundly Deaf)
FG3_R3	Cultural Liaison (CL) (Hearing)
FG3_R4	Transition Lead (TL) (Hearing)
FG3_R5	Speech Language Therapist (SLT) (Hearing)

Table 5: Focus Group Participants: Focus Group Three

Note on Educator Roles

A Resource Teacher of the Deaf provides specialist support of the d/Deaf or Hard of Hearing student and works with school teachers (Ministry Of Education, 2018).

Note on Results

The interview and focus group transcripts were coded with labels that described them, for example "*look I'm starting to think of Theory of Mind...because that is one area we work on a lot with our kids, yeah"* coded as "Theory of Mind". Initial coding resulted in 190 codes, which were then reduced and categories combined where appropriate. Further reduction of codes happened at the conclusion of the coding process, once all transcripts had been consecutively analysed. Full transcripts were shared with interview respondents and summary transcripts were sent to focus group participants to provide an opportunity for member validation. Once this process had concluded codes were again reduced, and three main categories or "themes" remained: Social Skills, Pragmatics and Communication; Games and User Experience; and Identity, Culture and Relationships. The aforementioned three categories were comprised of many codes, which described various connected areas of research interest.

Social Skills, Communication and Pragmatics

The social skills and pragmatics codes largely informed the main goals of the proposed intervention, and were concerned with identifying the concepts discussed by educators and parents regarding which social skills areas needed development. A full list of codes can be found in the appendix. The core concepts within the 'Social Skills, Communication and Pragmatics' theme were: conversational repair, contextual barriers, communication modality, theory of mind, self-efficacy and self-advocacy, vocabulary, and social-emotional areas. These areas are detailed in this section and inform the response to the primary research question regarding which areas of pragmatics require attention in the intervention.

Contextual Barriers

Contextual barriers was one of the largest themes, with educators providing rich detail regarding the environments and situations that can pose communication barriers for their DHH students. Group work was something described by educator and parent respondents alike as being problematic, and an educator in focus group one explained: *"Group situations where you've got multiple groups working in a classroom can be hard for the student, just because there's so much noise in the classroom. And of course, modern learning environments where there's a lot of kids in one space".*

The challenges experienced by DHH students in relation to group work are articulated by Gennari et al in their work on barriers to DHH students within group situations (Gennari, Pavani, & Rizvi, 2017). Some of the contextual barriers sub-themes that appeared strong across the data collected were: visual stimulation and distraction (and the associated high cognitive load), sports environments, and supporting self efficacy of students by encouraging use of audiology supports, accommodations and modifications, especially in learning environments where multiple teachers or many students may be present. Contextual barriers were frequently connected to the research areas of self-efficacy and self-advocacy, as respondents often mentioned encouraging DHH students to advocate for themselves when an environment was noisy or posed distracting elements, for example in modern learning environments. Respondents offered many examples of specific situations that would be challenging, such as catching the bus, what to do if you become lost, how to prepare for a job interview, and discussed particular challenges arising from times of transition, a pattern that was expressed by a number of respondents. For instance, the development of skills to limit the dislocating impact of a transition from primary school to

secondary school, and from secondary school to prepare for the barriers and challenges of independent living.

Conversational Repair

When educators were asked about social skills their DHH students found challenging they frequently responded with examples of conversational repair deficit. For example, questioning skills were said to be missing or lacking, with one RTD in a remote interview describing how he was '*doing an enquiry on question*' with other educators, to examine how these skills could be developed in their DHH students. Conversational repair strategies were a strong theme in the data and respondents in a focus group described how they would encourage their DHH students to '*fill in the gaps*' of missed communication by repeating what they did know, and asking their conversation partner to contribute the missing information. This strategy was encouraged, as peers may not wish to repeat the full sentence or conversational content. I4, a parent of young deaf sons described how hearing peers would refuse to repeat what their five year old son had missed in conversation by saying '*oh never mind*'. This appeared to be a common experience, with participants of focus groups offering similar examples. I3, a hearing parent of a deaf seven year old daughter described how her daughter would '*smile and nod*' sometimes if she had missed the meaning or content of a conversation exchange, and not seek to make clarification requests. In a focus group with specialists, a Deaf NZSL educator described how he occasionally engaged in similar behaviours if he had missed something in conversation. The '*Deaf nod*', '*smile and nod*' and '*masking*' were respondents' own words for the pattern of appearing outwardly to understand a conversation though missing the meaning of the communication exchange and not seeking clarification.

Modelling effective conversation repair processes where players do not experience negative real-life consequences from peers and are free to experiment could help significantly in the area of developing successful conversational repair strategies.

Communication Modality

Communication modality is a term selected to describe concepts relating to delivery of communication in various forms. Within this were various sub-themes, including educator's use of multiple communication mediums and attitude to and use of NZSL. The use of multiple formats to communicate a concept was a recurring theme, with respondents discussing how they would try to incorporate a range of methods of teaching or communicating a concept, such as through spoken and written English, NZSL, and with drawings, videos and role-play. Attitude to and use of NZSL describes respondents' and respondents' children and students' use of New Zealand Sign Language. The majority of RTD educators described the students on their caseloads as being 'oral deaf', meaning the student's main form of communication was spoken English. However, in focus groups some educator respondents discussed use of NZSL in a future intervention being desirable. It would be worthwhile investigating in future research efforts how many DHH students may have access to NZSL. Alternatively, an intervention that promotes bilingualism might be appropriate if it also offers captioned text for non-signing DHH students.

Vocabulary Skills to Support Social Skills

Most educator respondents discussed the importance of vocabulary skills to underpin social and communication skills. This appeared to be a foundational skill to

gain the meaning of a context and conversation and was described as a requirement for students to advocate for what they needed. Aspects of vocabulary that emerged as recurring sub-themes were the multiple meanings of words and the limited breadth of DHH students' vocabularies. Multiple meanings of words posed a problem for DHH students according to focus group participants, as one RTD respondent illustrated

"...we went through pictures and we talked about all the different ways catch and caught can be used, like catch a cold, catch a bus, catch up to someone, and she was just like ... it blew her little mind. She was just like, 'Oh my goodness, there's so many ways it can be used.'"

In addition, gaps in vocabulary meant students often had a limited range of descriptive words to pull from, as another respondent explained:

"And funny gaps in their vocabulary, so they use a more limited range perhaps, of words. You know, like, 'Big', whereas a hearing child might have quite a repertoire of words that could mean big."

There are implications from this for the use of language within an intervention for DHH students. Depending on the student's grasp of vocabulary, in-game language should be considered and inclusive, while ideally developing the player's expressive and receptive vocabulary and its uses in communication. Alternatively, resources or strategies used by educators might perhaps be help to support an intervention with related vocabulary learning to augment in-game learning.

Self-Advocacy and Self-Efficacy

Self-advocacy and Self-Efficacy were originally separate codes, however due to the regularity in which these areas were discussed together by respondents these concepts are described here in a combined fashion. Self-advocacy involves knowing

how to go about getting help, and as discussed by Luckner and Muir, strategies that can help students in mainstream education settings can include participation in setting Individual Education Plan (IEP) goals (Luckner & Muir, 2002). When asked about goals their students had, educators provided detailed goals. However, educators explained that their students did not generally come to them with their own goals, and one SENCO respondent described IEP meetings as occurring with the teacher and the parent/s rather than involving the DHH student. Parent respondents seemed generally unable to provide much information about their children's IEP goals. The author believes this may be indicative of a pattern where goals may be articulated at intervals throughout the school term but not actively worked on outside the classroom. Goal setting and working towards goals can provide students with feelings of self-efficacy and presumably the confidence to ask for and work towards the areas they may need more help in, a key component of self-advocacy. A digital intervention may thus help to remedy this situation by providing the player with clear goals that they understand and work towards, and generally developing their understanding of goal attainment. When asked about goals, participants in focus group one described how it was rare for their DHH students to come to them with a goal they had determined themselves. Respondents felt it was necessary to teach students how to set goals.

"*If they're not taught, they don't actually know how to set goals, or it would be very ... It's not common for a child to say, 'this is my goal and these are the steps I want to take'. Unless they're specifically taught how to do it.*"

In their work regarding the strategies that successful DHH students use, Luckner and Muir pointed to self-determination as being one of the salient qualities that successful students exhibited (ibid). Exposing DHH students to goal setting and attainment behaviours within the game intervention context may have potential to

improve DHH student's development in this area. Connected to goal attainment behaviours, a respondent who was a Teacher of the Deaf discussed risk taking being less evident in DHH students, and felt this was negatively impacting student's problem solving skills. She describes, *"That's another one that we feel we need to work on as our kids aren't very good risk takers or problem solvers, especially our ones on a case load or with an adjudicated teacher aide".* The respondent further commented that this might be due to well-meaning but potentially misguided protective motivations of parents or other adults: "*Sometimes I think they can be cotton wooled a bit and not really allowed to have the same things go wrong as a hearing child perhaps. In a nutshell, I don't think they're very good problem solvers from my perspective.*"

This can have flow-on effects, as fewer opportunities for experiential learning through risk taking may limit the development or strengthening of self-efficacy skills. A number of educators described protective tendencies of parents and though well intentioned, this may pose problems for the development of self-efficacy skills.

Theory of Mind

Theory of Mind was described by respondents in connection with DHH students' limited understanding of others' perspectives, motivations and emotions. Educators explicitly used the term 'theory of mind' in interviews and focus groups without prompting by the author. As focus group respondents described

"There's one other biggie, which isn't huge in our repertoire but we're finding out more about it is theory of mind. Are you familiar with that? So it's like understanding about different people have different perspectives, so we don't all know the same things and we don't all think the same things"

The respondents explained how skills in this area are typically delayed in DHH students and that these students might not *"know the motivation"* of other students, with one respondent offering the example of a DHH student becoming annoyed at a hearing student following her, only to discover that this hearing peer wanted to be her friend. In an interview with a hearing parent of young deaf sons, the respondent described how they were pleased upon discovering their five year old cochlear-implanted son had started lying, as it demonstrated he had developed theory of mind skills, saying, *"If he can lie, then he doesn't think that I know what he knows".* An RTD respondent who was Deaf himself further commented on theory of mind *"Well with theory of mind you're looking at emotion, how people think or feel"*. This educator worked on building these skills with students using the following strategy *"...I might play them a video of something that's happened (...) with my hockey boy again, we might think of it like I could use that video, play it and stop it just before his reaction and ask another kid to tell us what could be done. So he's actually learning from other people how to react"*. Developing scenarios within the intervention that help the DHH player to gain perspective about the motivations and perspectives of other people is therefore an important consideration for future intervention efforts.

Social-Emotional Skills

Social-emotional skills describes concepts relating to emotion recognition, management, facial expressions and body language to interpret the emotions of self and others. Respondents described explicit teaching in this area being necessary, and prior to the main research effort the author noticed a variety of paper-based visual materials on classroom walls within a DHH classroom to support this, for example images depicting happy and sad facial expressions. Educators generally described

their students as lacking skills in emotion recognition and wanted to work on developing these skills further, as one respondent comments *"They don't have strategies to realise when they're starting to get angry, so suddenly they're really angry, and they don't realise that there's a range of body language that encapsulates different levels of that emotion."* Building skills to recognise your own emotional reactions and those of others was further explained in an interview with a SENCO respondent, who discussed how they worked with students to teach skills in this area *"…they look at all their expressions and they learn what those are and then we teach them the vocabulary that goes with that. And a lot of the deaf children find that really difficult".* Based on respondent data it appears there may be a relationship between the vocabulary needed to discuss emotions, the ensuing development of,emotion recognition and management skills, and the impact development in these areas has on the aforementioned theory of mind skills and improved ability to navigate social situations.

IDENTITY, CULTURE AND RELATIONSHIPS

The 'Identity', 'Culture' and 'Relationships' codes largely informed the personas and scenarios that are articulated in the user experience recommendations and design chapter. They also helped to address the second research question '*who are the potential users of the proposed intervention?*' The core concepts within this theme were family dynamics and deafness, connection to Deaf community, cultural dimensions of deafness, friendships and relationships with hearing peers, stigma and acceptance, and societal inclusion.

Deaf Culture

Deaf Culture was a code chosen to describe the instances, customs, and experiences respondents described around 'capital D' Deaf identity. Members of this community typically describe themselves as a cultural linguistic minority rather than disabled. Access to Deaf role models and elements of Deaf culture was mentioned by respondents as being helpful for promoting a sense of identity and motivation for DHH students, particularly the educator cohort. The responses from parents regarding Deaf culture primarily centered on the type of media influences their children were exposed to and deaf peer groups and NZSL groups. Educators talked widely on the subject of Deaf culture and the sub-themes that frequently arose in interviews and focus groups were connecting with d/Deaf peers, i.e. through keeping in touch (KIT) days); positive Deaf role models and successful Deaf adults; NZSL access and promotion; and symbols of belonging. Educator respondents described instances where students had been reluctant to identify as d/Deaf, in some cases outright denying they were. Upon spending time with deaf peers, after a couple of months one such student was identifying as Deaf and had started to learn sign language. Such examples reaffirm research that suggests DHH students who have a connection to the Deaf community are likely to have greater self-esteem (Jambor & Elliott, 2005).

As mentioned by Korte et al, there are many dimensions of Deaf culture (Korte, Potter, & Nielsen, 2017). Respondents largely discussed students in the mainstream as being 'deaf' rather than 'Deaf', the former meaning the student has hearing loss but may not culturally identify as being Deaf and may not communicate with sign language. 'Deaf', by contrast typically describes members of the Deaf community who have an affiliation with the culture and use NZSL. This notion is well

summarized by Korte et al in their delineation of the terminology and applies to how d/Deaf has been used in this thesis.

NZSL Groups and Deaf events

NZSL groups were mentioned by respondents as being a source of connection for students to identify with others. As one parent of young deaf sons commented:

"... yeah he enjoys going, I think he likes hanging out with all the other kids and he definitely notices that, you know the(y're)*, Deaf, and he says things like, 'Oh yeah, they're the same as me', or 'they've got hearing aids like me', and...yeah...I think it's quite good for role modelling, anyway. Even if he wasn't getting any new sign language out of it, so even putting that aside, I think it's good that he gets to interact with other kids who are deaf, because, other than his brother, he doesn't really see anyone.".*

This connection to other d/Deaf peers was described as important, particularly in mainstreamed school environments where students may not encounter others like them on a regular basis. Focus group respondents reiterated the notion of NZSL as being important for cultural connection reasons, even if the DHH student had access to sound.

Deaf Media Influences

When asked about elements of Deaf culture they were familiar with, parents described the media their children were exposed to and this primarily included technology applications and television shows. One parent described a television show called Sally and Possum where the primary language used for communication was AUSLAN (Australian Sign Language):

"...So that's a Queensland -based TV show, that's AUSLAN, and they've got a sign woman called Sally, and I believe she is actually Deaf, and a Possum, named Possum and he is a, I think he's a child of a Deaf adult. And they're really cool. And it's bilingual, so there's English being spoken, and they're signing to each other all the time. But then when they've got somebody that comes into the storyline that doesn't know sign, it doesn't get interpreted into English"

The respondent appeared to view the demarcation of the show space as AUSLAN-centric in a positive light.

Cultural Dimensions of Deafness

Cultural Dimensions of Deafness is a code that describes where Deaf culture intersects with other cultural identifications, for example what it might mean to be Deaf in Pacifica or Māori culture. Educator respondents described wider representation of deafness within these cultures being needed, and in focus group three described the impact they witnessed when younger Pacifica DHH children could connect with older Pacifica peers. With these groups prominent in the hearing loss figures, it is necessary to address the meanings attached to deafness for particular cultures (New Zealand Ministry of Health, 2008). One respondent captured this theme well*"...within Deaf culture, there can also be pressure on the Māori kids to identify as Deaf rather than Māori. And the stigma about identifying as Māori as well Deaf."*

Friendships and Relationships with Hearing Peers

Resource Teachers of the Deaf often involved hearing peers into group work with their DHH students, in an aim to encourage learning about the accommodations and modifications required for full understanding, communication and inclusion of the

DHH student in the school environment. Describing her experience of running these exercises, one RTD commented:

"Interestingly, the children that came into the social skills groups with me and talked about good communication skills, they were much better at insuring they did that with their Deaf friend, whereas the kids that weren't involved may not have those skills. I think some kids just wouldn't think about it, and some kids don't have very good communication skills."

Rather than putting the burden solely on the DHH student to 'fit into' the learning context of the classroom, RTDs worked with schools, parents and the DHH student to try and create an environment that was suited to learning and inclusion. The sentiment of including hearing students in social skills learning activities was also expressed by a SENCO respondent in a mainstream school. The social challenges parent respondents discussed in relation to their child's friendships with hearing peers tended to be those in which the communication context posed significant barriers. For example, parties were discussed by two parent respondents as being especially taxing on their children because of the cognitive load of following multiple speakers and the challenging sensory environment.

Societal Inclusion

Societal inclusion describes inclusion and exclusion of DHH students within social settings. One of the recurring themes within this was that students may present as having strong friendships and relationships with hearing peers, but may be 'bluffing' during some of their interactions. The concept of 'bluffing' arose in several interviews and focus groups and was also termed 'the deaf nod' and 'masking'. When talking with parent respondents, there seemed to be a pattern of students knowing that they

are missing a segment of conversation but that they might pretend to have grasped what the other person said in a conversation. Such behaviour might perhaps be commonplace due to not wanting to feel conspicuous by asking one's conversation partner to repeat or rephrase, and in some cases may be due to the student experiencing past reluctance from other students to repeat what they have said. "Oh, never mind" seemed to be a regular phrase DHH students experienced when asking for clarification from their hearing peers, and was raised by parents as being a form of stigma their children encountered. One parent described an application her and her deaf daughter had used, which taught sign language using rhymes. The application had music that would accompany the sign lesson, which the respondent felt was probably inappropriate for an expected primary audience of DHH users: *"I know that, you know, Deaf people can enjoy music as well, but really, (...) the worse your hearing is... what's the point? Of being music-focused?"* This insight possibly represents a disconnect between efforts to promote Deaf culture and a potentially naïve understanding of the experiences d/Deaf users may have with technology and applications, given the focus on sound and music as a central component of the application. A conundrum for user experience research and design, the same respondent also discussed how her daughter would regularly wear headphones and listen to music on youtube, despite the likelihood she may not gain a good user experience from these devices due to her deafness. The author's impression regarding this is that DHH students' may want to use the same devices their hearing peers do, despite gaining a diminished experience from these.

Family Dynamics and Deafness

Family dynamics and deafness concerns concepts relating to families' interpretations and acceptance of the deafness of DHH children. Educators described varying levels of parental acceptance and involvement in the education of DHH children, with one respondent in focus group three commenting: "*Well I have one student who's been told not to sign in public because you don't do that. People will look at you*". I2, a SENCO educator discussed how one of their students had his cochlear implants turned off at home, and described other examples where students were likely lacking in their home learning experiences and opportunities:

"There was not a lot of support from home…his siblings were a lot older than him…he didn't really get particular personal experiences". Conversely, parent respondents involved in the research appeared highly accepting of their DHH children's deafness, were actively involved parents and had high expectations for their child's success. This likely has significant implications for DHH students' development of the language and pragmatic skills required for social communication.

Stigma and Acceptance

Perhaps one of the more connected concepts or themes, the stigma theme appeared linked to Deaf culture, self-efficacy and family dynamics and deafness themes. Stigma and acceptance describes respondent insights related to experiences of stigma they or their children or students had experienced in relation to deafness. When asked about their experiences of stigma, respondents provided examples of their children feeling anxiety or apprehension about wearing hearing aids, or gave examples of other children 'being shy' about talking about their hearing aids or cochlear implants. One parent addressed this by giving her daughter's hearing aids a name that made the

devices seem like jewellery, something that was of interest to her daughter. Though not as a response to questions regarding stigma, another parent of young deaf sons referred to her sons cochlear implants as his "*ears*" and would remind her son to '"*put his ears on*". A parent of adolescent deaf sons (12 and 15 years old) described how her sons had attended a deaf group once a fortnight, and that one of the deaf boys there had been reluctant to show his cochlear implant, hiding it behind his hair. This was in contrast to the girls in the group who would actively discuss their devices with the other members of the group.

Lower expectations of other adults regarding the possibility of the DHH student achieving academically or in terms of life outcomes was discussed by parent respondents as a form of stigma. One parent of Deaf boys described how their family strived to overcome such obstacles in regards to lowered expectations of other adults by communicating expectations of academic achievement. This respondent further described an instance where their child's hearing aid was creating noisy static and how a library staff member approached the family. Once informed of the cause of the noise, the staff member was described by the respondent as appearing "*overly concerned"* and apologetic, and commented "*you wouldn't want to be reminded*". High curiosity of hearing peers was discussed by all parent respondents and most educators of the deaf, with many examples provided by respondents of inquisitive children asking lots of questions of the Deaf student, particularly when their hearing aid or cochlear implant/s were visible. One hearing parent respondent regarded this interest as welcomed and helped their son to answer children's questions in the playground. Educators in focus group two also described past experiences of a mainstream educator's "unrealistic expectations" regarding a DHH student. Adults

were described as contributing more stigma compared to hearing peers curious about DHH students' hearing supports.

Games and User Experience

The 'Games and User Experience' codes largely informed the game intervention recommendations and were concerned with describing key areas of game mechanics and user experience. These concepts also helped to address the third research question '*What would an intervention require to be effective and desirable according to educators and parents*?' Salient concepts within the 'Games and User Experience' theme were: age, characters, consolidation games, game mechanics, user experience of games, applications and devices, games used by teachers and students, technology device use and aptitude, and teacher recommendations for the proposed intervention.

Age

Age was of research interest given the relationship between the difficulty level of the proposed intervention and the intended audience. It is a complex theme within designing for DHH students as cognitive and literacy levels may not necessarily be aligned with the demographic or chronological age of players. Whereas other games or applications may have a typical age-range, the balance of the game is more nuanced with this population. Age describes aspects of gameplay and user experience that are related to age, difficulty level and content. When discussing her deaf son's game preferences regarding Minecraft, one parent commented of her 12 year old son:

"A lot of his friends, because they're nearly teenagers now, a lot of his friends and kids at school are kind of out of that. Now they've kind of moved on to Fortnite and more complex games whereas he still likes Minecraft and kind of the more basic sort of games.". Examining which features might hold player interest regardless of age is worthwhile for the design effort, and one special educational needs coordinator (SENCO) described her feeling of surprise at how engaged her older students were when playing a game called Lexia Core 5 that she had thought was perhaps not age-appropriate:

"…even our senior children who have had some learning difficulties…, I thought the program was really simple, but the level of motivation through just those really simple rewards just really keeps them going".

Despite being perceived as basic, the longevity of gameplay and sustained player interest in these games could be due to careful consideration of the game's mechanics and reward systems, with students who played the game mentioned ranging widely in age. When the author visited classrooms to do informal observation prior to the main research effort, young students between the ages of 6-12 described Roblox and Minecraft as being their favourite games (Roblox Corporation, 2018) (Microsoft, 2018). It seems these games successfully engage a range of players across age cohorts.

Consolidation Games

When asked about their use and thoughts regarding games, educators often raised the concept of consolidation games, where they would use what was being taught in the classroom or an interest of their student to develop a small game or exercise for review. Mathematics consolidation games appeared widely used, with one early

childhood teacher describing how she utilised tactile blocks as a method to convey ‘what five felt like’ for her student who was deaf. A Special Educational Needs Coordinator respondent further added to this theme, explaining:

“In class, you know there will be consolidation games, in say maths and things like that and activities and they happily get involved in those, the teachers have taken extra time to make sure they really understand them...then they get involved in all of those things, yeah.”.

Resource Teachers of the Deaf seemed to be active creators of consolidation games, with one respondent describing how she would create games ‘on the spot’ based on what the students were learning at the time.

“I'll just go scan through my brain quickly, just make up a game that relates to that to try ... You know, they're quite often doing worksheets or something (...) so then they might finish the worksheet, and then we'll build it up using a game…”

RTDs explained that the games were usually language-based, though other subjects such as mathematics could also have spontaneous games derived to augment learning about concepts, with one respondent giving the example of consolidation games to reinforce recent lessons about fractions. One parent respondent elucidated further, describing how the RTD who worked with their son would introduce further opportunities for learning into games that may not possess much educational content: “*she like inserts extra learning into games that don't really have that”.*

Role-play was an additional strategy that almost all educator respondents either explicitly referred to, or alluded to via their descriptions of teaching strategies used at school. A resource teacher of the Deaf described how DHH students would need opportunities to ‘play out’ scenarios and discuss social skills:

"…they need the chance to review or recap or to play out scenarios…like I do a role play, so that they have an understanding of how they can react".

Role-play was also described by a parent respondent (I7) as being a strategy she employed in the classroom in her role as a special education teacher aide. Parroting techniques helped the respondent's students on the autism spectrum learn what was expected in various social situations, with teacher aides speaking phrases aloud and having students repeat it back. Such strategies likely offer the student the security of having some rehearsed phrases they can draw from in communication scenarios.

Characters

Respondents suggested characters within the game should include diverse representation of ethnicities who use a range of devices, for example hearing aids, cochlear implants and FM systems. Respondents in focus group three discussed the possibility of including cultural elements relevant to the New Zealand context, specifically representation of Māori and Pacifica characters. The author suggests characters in the game environment express a diversity of cultures to further provide DHH players visible examples of Deaf culture that they can identify with. This is particularly relevant to DHH students in the mainstream, as they may have little exposure to Deaf culture or d/Deaf peers.

Game Mechanics

Game mechanics are the components of games that drive the gameplay experience and contribute to engagement of the player in the game environment. Schell defines game mechanics: "Game mechanics are the core of what a game truly is. They are the interactions and relationships that remain when all of the aesthetics, technology, and

story are stripped away" (Schell, 2015). Game mechanics that were discussed widely by respondents included levels and progression; visual feedback; reward; interactivity; clear communication of game goals and choice, among others.

Within the wider theme of game mechanics, the levels and progression theme describes instances where respondents discussed levelling systems of games and applications. This emerged as a recurring theme and is thus considered of importance for game-based interventions in this area. Though there might be some hesitation regarding designing an intervention that poses a challenge to the user when they may have difficulty in areas of communication, in interviews parents and teachers alike discussed engaging and appropriately balanced levels as being something their students would appreciate in a game-based intervention. During focus group two, Teachers of the Deaf explained how their students approached levels in games *"…they're like, 'oh we've done that. We've done that. Oh, we're nearly at ten'. And they do talk about it quite a bit. 'Oh, we're halfway there. Oh, we're nearly there".* Levels and clear progression reinforcement may offer DHH students motivation and engagement to progress regardless of the sophistication of the game, as described by I2, a SENCO respondent *"…surprisingly to me, I thought they would've wanted something far more, but no, level jumping seems to be a key".* I2 further described game mechanics that assisted with this engagement being progress bars and a visual reinforcement of the student's learning journey through their travel across a map within Lexia Core5 (Lexia Core5 Reading, 2015).

Choice was a recurring recommendation of respondents, and a participant in focus group three suggested the following *"I think giving them some choice around how they would react and learning through, well I chose the wrong one, so I won't do that again".* Provision of choice and consequences for the selected choice would likely

offer the player a safe environment in which to experiment with social strategies within the game.

Interactivity and Multiplayer describes concepts discussed by respondents related to interactive mechanics and multiplayer elements of games. Respondents generally expressed that the more interactive a game-based intervention was the better, with some educator respondents suggesting the possibility of DHH students and their peers being able to log into a system to facilitate experiential learning within a group. I2, a SENCO described how her students worked on an iPad based game together in person, offering advice and tips to each other to advance through levels.

The visual reinforcement theme described graphic and visual elements within games to aid understanding of game content or to reward the player. A Teacher of the Deaf commented regarding visual content in games *"The obvious things that they'd go for is they'd ignore a paragraph of text, but if they saw an arrow or if they saw a door or if they saw something like that, their natural thing is just to go there and just explore*". Respondents suggested visual elements needed to be highly engaging and effectively communicate whilst also not being distracting to the point that DHH players were distracted from core gameplay elements.

The related theme of 'reward' concerns ideas expressed by respondents regarding game rewards for players. Respondents had many suggestions for forms of rewards the intervention could offer including: secret objects being revealed, a backpack to collect objects earned during gameplay, streaks, customisations and visual celebration of a level or game goal being achieved. As a parent of deaf sons put it *"some sort of celebration, of achievement"*.

Clear goals were also described as being important for DHH students, and educators described their own teaching practice being informed by concepts like

'scaffolding' and 'explicit teaching'. A pattern of goals or learning content being broken down into manageable steps emerged, as a respondent in focus group three illustrates "*Okay, so this is what you've got to get done. Or, this is your end result. How are you going to get there? What steps are you going to put in place to make sure that you get there?"*. Signposting the intended outcome or objective of a level or goal, and breaking this down into steps the player can easily grasp is therefore recommended in the intervention.

User Experience of Games, Application and Devices

All respondents questioned described their students or children as effective users of personal and entertainment technology, for example of iPads, mobile phones and gaming consoles. Some parents restricted their children's access to devices like iPads to weekends-only, and characterized their use of such devices as highly competent. Device use of iPads in the classroom appeared restricted to a small number of trusted applications, and teacher respondents within a focus group mentioned that a "screen lock" function would be important for the usability of a future digital social skills intervention. One parent described her dissatisfaction at an NZSL rhyme application that employed a large amount of audio content, as she felt it missed the mark if designed for a primarily deaf audience. Educators described guided access functionality as being important for applications used in the classroom, as this could ensure students did not use devices for other applications. Applications that respondents felt were good examples of technology-based learning were the NZSL Sign Ninja app and the My World Tool counselling tool for deaf children was discussed by an Audiologist (Sign Ninja, 2018) (Ida Institute, 2018). This was contrasted with respondent's comments regarding their student and children's use of

audiology technology and devices, with some teachers describing how they were concerned that the student would forget to monitor devices or equipment necessary in more independent learning contexts.

One parent respondent who had young Deaf sons commented that unless she would "*sneak ears*" onto her son, or remind him of the need to make sure his cochlear implant was on, he would not do this or monitor it himself. However, the child would use the family's iPad to source sign language content to show adults close to him, effectively using the iPad as a mechanism to introduce others to sign language and teaching older extended family members some signs.

Another hearing parent of a deaf seven year old girl described how some of the communication barriers her daughter had experienced in the past had been due to her hearing aid running out of batteries, though this was eventually discovered by her teacher. Raising a salient concern, the respondent mentioned how this poses difficulties as "*if you don't hear, how do you know what you've missed?*"

One's ability to advocate for what they need to participate in the classroom is clearly impacted by such missed communication. This suggests that monitoring of the communication and learning situation requires highly active monitoring of the student by the teacher or the student themselves, something that may not always be possible for teachers in mainstream classroom settings who need to manage many students simultaneously. Developing DHH student's self-efficacy and "self-management" skills is thus important to encourage full participation in learning and social activities.

Games and Applications Used by DHH Students

Games that were routinely described by respondents were Mathletics, Lexia Core 5, Minecraft, Sign Ninja, Fortnite and Socially Speaking (Lexia Core5 Reading, 2015)

(Billard, 2003) (Sign Ninja, 2018) (Epic Games, 2017) (Schroeder, 1996). When visiting classrooms prior to the main research effort, students between the ages of 6-12 mostly mentioned Roblox (Roblox Corporation, 2018) and Minecraft (Microsoft, 2018a). One of the key components of Minecraft and Roblox is the flexibility and freedom of expression players have to create their own worlds within the game, and one Teacher of the Deaf described her surprise at the high level of detail and creativity her student exhibited within in-game creation, something she would not have expected of the student in question. Minecraft and Roblox allow player creativity and self expression through their construction of environments in the 'game world', and this is likely why they are so popular with students. This potential of games to inspire student learning is mentioned by Cipollone et al as being a quality that could be utilized for creative learning (Cipollone, Schifter, & Moffat, 2014). Such games do well at boosting feelings of relatedness (Riordan & Scarf, 2016) and autonomy, central components of self determination theory as mentioned by Ryan and Deci (Ryan & Deci, 2000). Socially Speaking was utilized by educators to facilitate group discussions with other students around social skills and is designed to address gaps in social skills knowledge of students who may have learning difficulties (Schroeder, 1996).

Technology Device Use and Aptitude

Parents and educators described DHH children and students as competent and enthusiastic users of technology in many forms. Depending on the age at which a student would seek to access the game, teachers and parents can be described as secondary users of the intervention, as they are the decision makers and could determine DHH student access to such a tool if the interested player was under 13.

Purchasing decisions, opportunities to use the app and the owning of an appropriate device to access the intervention on are thus important user experience considerations. When educator respondents were asked about device use in the classroom, the general response appeared to be that they actively supported iPad use. However, educators desired the ability to ensure devices were only used for specified applications. Mobile phones were described as highly important to DHH adolescents in focus group three.

Teacher Recommendations for the Game

Respondents in focus group one described how an ideal outcome of the intervention would be that DHH students would be able to transfer in-game learning to their daily lives, thereby increasing confidence in social communication, saying:

"So they practice doing some social situations on the screen, and it's less sort of threatening, then hopefully they can then transfer that into a real life situation".

This reinforces McGonigal's idea of games as involving 'fun failure', which can provide a safe context in which to experiment and learn (McGonigal, 2011). Another recurring 'ideal outcome' was that an intervention could also include learning for hearing peers. A respondent in focus group three who held a professional role as a transition lead discussed an ideal intervention being "*as authentic and contextual as possible*" and further suggested virtual reality as a means to create an interactive and contextual training mechanism for students.

Ideation Activity Responses

Presented in the following pages are the responses from focus groups conducted with educators. Each respondent had their own post-it note colour in the ideation segment of focus groups and respondents' concepts, ideas and suggestions are illustrated. This segment of the focus groups typically became livelier and respondents seemed active and enthusiastic about contributing their ideas and discussing other's ideas. For full photographic data captured of the ideation prompts please see the appendices.

Ideation Questions	FG1 Yellow Post-Its	FG 1 Blue Post-Its	Supplementary (provided via email)
A1: *What hobbies do your students enjoy? How could these be used for additional learning?*	Superheroes: role playing, pictures linked to language needs eg body parts/ clothes; animals - link vocab; Lego (preschooler/primary), barrier games, postional language; Culture interests, culturally responsive books; Sports, deaf sports role models	Spy novels: write clues, following sequences, using interest, ideas for writing, making resources related; Orienteering: listenting activities, giving directions, prepositions	
A2: *What would a game/tool for social communication skills need to have, to meet the needs of DHH students?*	Characters facing us, not too much visual distraction behind characters; Different levels, Language they understand, choices to make, captions; Age appropriate; Characters not speaking too fast, ability to slow down speech of characters; Feelings, plus recognising how your body reacts, Emotions, different levels of intensity, recognising facial cues, body language (arrow to another post it) - Realistic meaningful situations that they may encounter; Characters who are deaf, sign, talk, use devices - Culturally responsive, particularly Pakeha, Maori, Pacifca characters + a smattering of others.	Good response time; opportunities for practice; lots of visual content, carefully worded text; Agreed upon guidelines for good communication in group; rewards (chance for break); choices, consequences for choice	
A3: *What would it need to have to be fun or enjoyable to use/play?*	Opportunity to try situation again; Unlocking options as you progress; Venues: fast food, friends house, school, party, park/beach; Dress your character, avatar/ choose age of character. Type of hearing device; Postive response or visuals when good choice made (arrows to next post it) Unlock rewards/ objects, key (appears connected to positive response when good choice made point), NZSL dictionary app, Backpack or purse to collect objects in	Using the name they provide "Hey Sam"; Using language that kids actually use, scenarios meaningful; Interactive, making choice, avatars, colourful	
A4: *Frustrating situation - what would the response be? What might help or hurt?*			Frustrating Situation. Response could be… -Withdrawing from the situation -Misinterpreting the situation -Getting physical -Blaming others -Telling, asking for help What would help/hurt? -Help: scaffolding them to think through the
A5: *Media requirements for the game/app?*		Different stages and levels of social skills eg higher level for high school	

Table 6: Focus Group One Ideation Responses. Part 1 of 2.

A6: *Scenarios - what scenes, situations or places would be helpful to*	Group discussion of where next, missing the group consensus; Missing the punchline of a joke	Not hearing parts of conversation, asking for clarification; In the car with family; In the playground	
A7: *What would success for your DHH students look like?*	Knowling what they need as a deaf learner, in order to learn eg: where to sit, captions, move out of the bright light (arrows to next post it to show connection); break down instructions, extra processing time, visuals; Advocating for self if they miss info, having friends; Treating their friends right; Interacting with a wide variety of people; Transferring social skills into different contexts, Using jargon, Understanding Jokes*; Recognising social cues + body language	Being able to start and maintain a conversation; being able to ask for clarification rather than bluffing*	Success would look like: -Understanding social cues -Transferring social skills to different situations -Asking for clarification when not understanding/mishearing -Advocating for self eg: asking someone to move seat so you can sit where you need to
A8: *What resources exist already? What would you change or keep the same?*			Resources we already have: -Books with skills and ideas for teaching, worksheets to photocopy and use -Photos of faces with different emotions, emotions posters
A9: *In an ideal world, what could the game/tool be or*	Students playing with other students eg both have a device and they can see each others avatars.	Help students feel comfortable advocating for themselves.	
A10: *What elements of d/Deaf culture would you like to see included in digital tools?*			Deaf culture elements: -Eye contact - Flashing light on/off to get attention -Getting attention by hand waving, tapping -Using an interpreter/communicator

Table 7: Focus Group One Ideation Responses. Part 2 of 2.

Ideation Responses from Focus Group One

Notable user experience and game concepts that emerged during the second focus group were the importance of levels and progression from easy to hard, engaging graphics, ease of login, player customization and clear facial expressions on characters or otherwise the ability to 'enlarge' relevant graphics. Respondents mentioned the possibility for an intervention to include both DHH and hearing peers. In terms of the pragmatics skills discussed, respondents gave examples of developing student confidence in expressing their needs and being acknowledged by others. The responses to the 'frustrating situation' largely concerned the DHH student giving up during conversation, feeling ignored by others and lacking confidence to employ conversation repair strategies. Teachers of the Deaf in this focus group communicated with their students with both NZSL and spoken English, and this bilingualism was a recommendation for the intervention.

Ideation Questions	FG2 Orange Post Its	F2 Yellow Post Its
A1: *What hobbies do your students enjoy? How could these be used for additional learning?*	Make believe: Frozen, Moana; Sports (team) : rugby, soccer, b'ball; Drama role plays; Martial arts; Family (sharing)	netball, rugby, soccer, basketball; Karate, music, listening to, playing piano; Crusaders-visual connections*
A2: *What would a game/tool for social communication skills need to have, to meet the needs of DHH students?*	See student progress (+ dashboard); 'Pimp your person' - gaining money to buy things; Modules able to be chosen (teachers); (arrow to next post-it) Levels students see progress (go noodle); not much reading (oral/ sign); being able to link the class members together; easy to log into	Visual-engaging pictures; steps-clear info; settings-varied-real or - familiar; informative-learn new things-maybe current events, factual
A3: *What would it need to have to be fun or enjoyable to use/play?*	Learning through play; progressive (easy - hard); being able to 'level up'	having NZSL to support understanding; success thru levels/ activities; -(arrow) people they can relate to; places they can relate to;
A4: *Frustrating situation - what would the response be? What might help or hurt?*	not hearing something -get defiant -understanding strategies (arrow) frustrated they didn't hear/ not wanting to admit it	speaking to person who don't understand so turn and walk away mid-conversation; feeling ignored, so give up; having confidence to try again to communicate; asking for clarification - asking, 'please tell me again'; mis-communication or missed communication
A5: *Media requirements for the game/app? What would it need to have and why?*	Able to enlarge text/images; emotions on peoples faces clear; work well on 'guided access' iPad; computer + ipad	body language clear-easy to interpret; password to access-personal account
A6: *Scenarios - what scenes, situations or places would be helpful to include in the game?*	school, home, library, sport field, shops; meeting someone new (nicely); introducing a friend to someone	Asking for help or support; Restaurants, fast food experiences; School playground sports field
A7: *What would success for your DHH students look like?*	being able to have a fufilling career; being future leaders + advocates; Achieving to their full potential	Can confidently express needs & wants; Able to communicate and be acknowledged; People using NZSL with them; Having a range of options for jobs
A8: *What resources exist already? What would you change or keep the same?*	Black Sheep (photocopy), social skills -listening	Use a lot of picture books to initiate conversations
A9: *In an ideal world, what could the game/tool be or do?*	Be a game for DHH + hearing students; help to develop confidence in communication	-nominate at start, deaf or D11; engaging -want to move on, want to achieve; real situations for students - relatable
A10: *What elements of d/Deaf culture would you like to see included in digital tools?*	not sloppy signing; Eye contact; positioining ie sun	Face to face; clear communication - no need to yell; Light/dark; How to get attention; Rules of conversation eg please slow down, please tell me again

Table 8: Focus Group Two Ideation Responses

Ideation Responses from Focus Group Two

Notable user experience and game concepts that emerged during the second focus group were the importance of levels and progression from easy to hard, engaging graphics, ease of login, player customization and clear facial expressions on characters or otherwise the ability to 'enlarge' relevant graphics. Respondents mentioned the possibility for an intervention to include both DHH and hearing peers. In terms of the pragmatics skills discussed, respondents gave examples of developing student confidence in expressing their needs and being acknowledged by others. The responses to the 'frustrating situation' question largely concerned the DHH student giving up during conversation, feeling ignored by others and lacking confidence to employ conversation repair strategies. Teachers of the Deaf in this focus group communicated with their students with both NZSL and spoken English, and this bilingualism was a recommendation for the intervention.

Ideation Questions	FG3 Pink Post its	FG3 Cyan Post its	FG3 Orange Post its	FG3 Blue Post its	FG3 Yellow Post its
A1: *What hobbies do your students enjoy? How could these be used for additional learning?*	Kahoot quizzes - competitive learning; Board games - strategy thinking, battle ships, problem solving; gaming! - building on scenarios - right/wrong outcome; Storytelling -learn their history etc	weaving - how to, carving -meaning of, haka -when + where, taiaha - how to	Guess who; phones, sports, games, gossip and news to figure out; Sports, visual, camps; quizzes, links back to something that is part of who they are	Cards - games, Visuals -who am I, headbanz; Sport - using scenarios that include sport/images	accessing music for dance
A2: *What would a game/tool for social communication skills need to have, to meet the needs of DHH students?*	Choice; Clear, plain english/language (little amount; contextual and authentic; Perfect scenario, clear options (?); Problem-based -grapevine; Take 1 perfect scenarion, Take 2 Run the scenario with choices - gamer decides which path to take to get to the desired end result.	multi-bi cultural contexts + figures; role modeling	Objects, showing the real world; Take things, film, what would you do in this scenario? Short video; Sign language, visual pictures; Video clip, creative skills to think about before and after, what are they thinking?; Visual	seeing it unfold - seeing as much as possible, able to review repeat; Visual representations of scenarios; Made in 3 languages NZSL, spoken english, Maori; Scaffolding maybe levels easy - hard; Clocking each level (tick drawn by respondent)	sign lang; what would the end look like; visual cues; ask deaf students*; what happened before this situation?
A3: *What would it need to have to be fun or enjoyable to use/play?*	Interactive with other players/ avatars; Interactive; choice based; fast paced - time based; colourful, animates, cartoon; Builds a sense of community;	age appropriate, culturally appropriate; strengths -based	Active + visual; vocab in sign, NZSL bites*, connected with curriculum, create something fun; segment		
A4: *Frustrating situation - what would the response be? What might help or hurt?*	Helpful (underlined by respondent) Being brave enough to ask for clarification; How to manage their own behaviour = options for Calming down/ time out; Physical reaction - punching the wall, slamming the door; Group-conversation walk away frustrated; Being able to question is an important skill; Help Understanding the communication frustrations - what are they?	having a safe space to go - community; self affirmation (horizontal line over post it note) building a strong sense of identity; knowing their own values	Language base to have enough bravery; responding incorrectly, nodding, put a mask on*; Behaviour might change, might ignore others, figeting, attention from others; Lack of understanding about communication barriers, becoming passive, masking		not hearing other family members at dinner table; the patients check if conversation is being followed; use parents (?) opportunities to need (?); not hearing another student in class, ask others to repeat, other student might refuse to repeat; New teacher refuses to wear radio transmitter*, student explains need, teacher flatly refuses to listen and comply
A5: *Media requirements for the game/app? What would it need to have and*	no background music to distract from the main audio; Bandwidth friendly; thought or speech bubbles for characters; Easy -to operate -	cultural representation avatar wearing - tamoko pounamu etc -hearing	Representing rhythm visually, waterfall indicate, rep music/audio visually		captions & NZSL, video; clear speech for spoken segments, sentences not too long; no background music & noise during spoken sequences

Table 9: Focus Group Three Ideation Responses. Part 1 of 2.

A6: *Scenarios - what scenes, situations or places would be helpful to include*	Playground social interaction (horizontal line) Home life; Job interviews (horizontal line) applying for winz benefit (horizontal line) Going to the	marae, tertiary contexts, library - café; family contexts -tangi - dinners -parties	Deaf class, Deaf rugby, the Deaf games, Binannually, Easter time tournament		-hearing clinic -medical appts - classrooms -home -shops - public transport -friends - clubs/sports
A7: *What would success for your DHH students look like?*	Being able to generalize the skills learned in the game, in real life situations; Self-belief; Being confident independent contributors to Society; Self-	strong sense of identity; communicating their pepeha; knowing their	IEPs: what it is to be successful, being encouraged, being positive, finding own path		-satisfactory conversations - feeling good -conversation partner feeling good; being able to support one's self
A8: *What resources exist already? What would you change or keep the same?*	second life		VIST* curriculum games, specifically for Deaf, NZSL curriculum		Look at Deaf/ HH websites; Ida Institute "my world" tool; -see youtube video by "Zina Jawadi"
A9: *In an ideal world, what could the game/tool be*	as contextual & authentic to real life as possible; VR			culturally representative	virtual reality to model situations
A10: *What elements of d/Deaf culture would you like to see included in*	signing employees in shops/ fast food places	NZSL	Poolside starter gym (?) difference between Deaf culture, Deaf short film fest, Storytelling; Senior citizens groups, Strong		modeling of deaf/HH in workforce

Table 10: Focus Group Three Ideation Responses. Part 2 of 2.

Ideation Responses for Focus Group Three

Notable concepts that emerged during focus group three were VR, with two respondents placing post it notes describing 'VR' on the ideation sheet. One of these respondents discussed how she would role-play transition-related topics with her students, and how this could be better enabled with virtual reality tools. An audiologist respondent also listed VR as an avenue that had potential for DHH students in the area of social skills, and discussed a tool in the counselling area for DHH students called 'My World' developed by the Ida Institute (Ida Institute, 2018). A Deaf NZSL tutor discussed how he would place earmuffs on hearing parents of DHH students for them to experience what their children experience, and how this engendered empathy and more understanding of their child's lived reality. Interactivity, experiential media, cultural representation and strong ties to community

for developing students' identity were strong themes from the ideation segment of focus group three.

Concluding comments on Results

Findings from three interviews with parents, four interviews with educators and three focus groups with educators and DHH specialists have been presented in this chapter. The main insights gained from the primary research enquiry were that the identified areas of social pragmatics were validated as being important areas for intervention efforts. Additional areas that respondents described as important were: social-emotional learning, for example in the areas of facial expression recognition, emotion labelling and body language, communication modality which included the concepts of NZSL usage and reinforcing learning through multiple modes of communication - for example through visuals, drawing, role play and text. Game and user experience findings included game mechanics recommended by respondents, such as levels, engaging graphics, interactivity, choice, representative characters, and captioned text. User experience recommendations were also made by respondents regarding settings and dashboards for educators, for instance educators indicated their preference for guided access and lock functions that could limit students to playing the game intervention rather than accessing other applications while using an iPad or tablet device in class. This may however not apply to an older user cohort of DHH adolescents. Educators also recommended dashboards for tracking student progress.

CHAPTER 5: DISCUSSION

Results are discussed in this chapter, with commentary around the implications of the analysis provided. The themes are discussed in relation to how they have addressed the research questions. Key themes for inclusion in the proposed intervention are discussed and explanation given regarding scope and potential for improved and extended research in the future. The interview and focus group results largely conformed to three main thematic groupings, which did not substantially change at the conclusion of the research. 'Social skills, pragmatics and communication' describes results addressing the first research question 'what are some salient themes from the primary data that could be useful for designing digital social skills interventions for DHH students?' Research question two was concerned with identifying patterns of experience of respondents' DHH students, and is explained by data from the 'Identity, Culture and Relationships' theme. Research question three sought to uncover recommendations for the game intervention and is addressed by the theme 'Games and User Experience'. Finally, limitations of the research endeavour are articulated and future work to extend the field proposed.

SOCIAL SKILLS, PRAGMATICS AND COMMUNICATION

Research Question One was concerned with identifying themes to answer the question '*How can we best design a digital social skills game for DHH students?*' As previously discussed in the results chapter, many areas of social skills, pragmatics and communication warrant investigation and implementation in a future intervention. However, those that recurred consistently were conversation repair, contextual

barriers, communication modality, vocabulary, theory of mind, social-emotional understanding, and self-efficacy and self-advocacy. Prominent within these were practical suggestions for questioning strategies and review to aid conversation repair, and educator respondents provided many examples of contextual barriers their students faced that would be good to role-play within an intervention. The original themes articulated in the related work chapter were validated as important based on the collected primary data. Emergent themes of vocabulary, social-emotional learning and communication modality arose consistently in the data and are therefore suggested as additional considerations for the future intervention.

Self-Efficacy and Self-Advocacy

Self-efficacy and self-advocacy concepts seemed intertwined, as respondents would frequently discuss these concepts together. Examples of effective strategies around self-efficacy and self-advocacy were often connected to self-management, for example regarding device use of supports such as hearing aids, cochlear implants, additional learning materials and FM systems, and organising and appealing to others such as teachers and peers to aid in their effective usage.

Students increased participation and exposure to a range of social interactions was discussed as needed by a TOD respondent, who described parents and educators as occasionally limiting the DHH student's access to full learning opportunities and problem solving. Offering students opportunities to practice problem solving in a medium that does not have the social consequences present in real interactions may therefore increase feelings of resiliency in Deaf students. Students of parent respondents were described as having relatively high levels of self-efficacy and goal setting behaviours, and had strong family support, factors described as influential

contributors to student success as illustrated by Luckner & Muir (Luckner & Muir, 2001). This is likely not representative of the experience of many d/Deaf and hard of hearing students in the mainstream. These students may be facing substantial challenges not fully explored in this thesis, and the author would recommend further exploration of the DHH student experience in mainstream education settings

Communication Modality

Using multiple methods of communication was strongly recommended by educators, for example by communicating or teaching a concept to their DHH students using a combination of written and spoken English, NZSL, visual aids, drawing and tactile strategies as well as role play. Pre-teaching, explicit teaching and role-play were recurring concepts, with respondents frequently discussing 'pre-teaching' content connected to learning areas as being important for their DHH students. To illustrate, educators discussed teaching some vocabulary items that might be required for a subject or modelling strategies for the student prior to an activity commencing. This may enable the DHH student to focus on an activity and participate in the learning experience more fully. The importance of using a variety of communication mediums to support DHH student learning is further recommended by the Ministry of Education and Mahshie et al (Ministry Of Education, 2018), (Mahshie 2005).

In terms of communication modality implications for the intervention, the author recommends game content be primarily visual with simple captioned text to support communication, given the range of DHH student vocabulary levels and variability in the use of NZSL described by respondents. This recommendation is based on data that indicates the prevalence of DHH students' use of spoken and written English as a

primary form of communication, particularly those students in mainstream education settings. Future iterations of the game could incorporate NZSL more prominently as specialist educators suggested this was important, especially for providing exposure to Deaf culture.

Social-Emotional Learning

An emergent area of social skills and pragmatics concerned developing DHH students' skills in emotion recognition and management. The author recommends content that can develop emotion recognition and management skills. Developing content in this area could also help with theory of mind skills, as recognising other's facial expressions and body language can help one to infer emotional states in others, and can assist in gauging what others may be feeling. With skills in this area, students may then be able to select which repair method might be best during conversation. For example, upon seeing someone's frustrated facial expression and body language after an interaction, the student could then opt to rephrase their question, using what information they have to fill in the gaps rather than have their communication partner fully repeat a statement. Supporting resources might serve to reinforce this with visual depictions of common conversation elements, facial expressions and simple explanatory text. Additionally, game mechanics that support the player needing to grasp the meaning of a facial expression within the gameplay may serve to reinforce learning in this area.

Research question two focused on identifying common patterns of experience and sought to identify information relating to the proposed users of the intervention. The question was '*Who are the potential users and which characteristics are shared amongst respondents? Are there patterns of how DHH students communicate with others or what they might need in this area? What are user's goals and motivations?*' Key concepts to address this theme included Deaf Culture, Family Dynamics and Deafness, Friendships and Relationships with Hearing Peers, Stigma, and Societal Inclusion. This research question was additionally answered in the creation of designed personas and scenarios describing proposed users of the intervention, which can be found in the user experience and design recommendations chapter.

Stigma was initially defined as an area of pragmatics enquiry, but on reflection, discussion with respondents and reviewing the literature the author feels this is more appropriately captured in the 'Identity, Culture and Relationships' theme, given the cultural dimensions of stigma. For example, different cultures attach different meanings to deafness. Further, respondents often described stigma around deafness being lessened by their DHH students having exposure to other DHH students and adult Deaf role models, so there may be a relationship between connection to Deaf culture and community, and an ensuing protective guard against stigma. To illustrate, one educator described one of their DHH students refusing to identify as deaf. After this student had spent a few months in the company of other DHH students, he was learning NZSL and describing himself as deaf. Another Deaf educator who was Deaf himself described his experience in the mainstream as being lonely and isolating as he

did not see others like him, but that his experience changed upon exposure to the Deaf community.

Family dynamics and deafness was a code explaining family attitude to the deafness and acceptance of the deafness seemed to be a protective factor against stigma following discussions with respondents. Home learning was discussed by educator respondents as being variable, with some students arriving at primary school with little to no communication skills. RTD respondents primarily worked with DHH students whose primary means of communication was written and spoken English, sometimes referred to as being oral deaf, and their students had varying degrees of exposure to the wider deaf community. This can have implications for inclusion, as DHH students who have 'bicultural skills' in both the hearing and deaf worlds may have greater levels of success and inclusion as described by Gibbons (Gibbons, 2015). Those students with a strong sense of self and connection to their Deaf identity and culture may also have greater levels of self-esteem as illustrated in the work of Bat-Chava (Bat-Chava, 2000).

Games and User Experience

Research question three was concerned with unearthing respondents' recommendations regarding games and user experience elements of the proposed intervention. Results relating to this question can be found in the 'Games and User Experience' section of the results chapter, and advice is provided that addresses this research question in the User Experience and Design Recommendations chapter. Educators described their high interest in accessing any resources they could get in

the area of social skills, and typically described resources being scant in the area of social skills. At a first stage, an iPad-accessible intervention is recommended. iPads were in widespread usage as teaching tools in classrooms, though may not be as common in students' homes. DHH children and youth may have varying access to these at home due to parental limits or lack of these devices altogether. Mobile phones seemed to be a key method of communication of older DHH students according to respondents in a focus group of respondents who worked closely with DHH adolescents, and the author recommends future consideration of this medium for an intervention. Due to the perceived difference in device use in the classroom compared to home-use, the author recommends a cross-platform solution that can be compatible on a variety of devices, or be iPad based given the high prevalence of these in classrooms. Access to the devices with which to use such an intervention would need to be agreed upon by educators and ideally the student would have regular access to the intervention. Resource Teachers of the Deaf, and Teachers of the Deaf are uniquely placed to leverage such a tool, and having functionality where these specialist educators could augment game learning in person with their students would be a good review strategy. As such, a mechanism that would allow educators to track DHH player progress might provide rich information to include in further developing social skills and pragmatics areas with DHH students and mainstream teachers.

LIMITATIONS

Limitations of the research are discussed in this section. Key limitations include the scope of the project, recruitment of mainstream educators and parents, and participant characteristics.

Project Scope

Conducting a qualitative research project using grounded theory methods was ambitious in the time available, and some of the data was unable to be fully saturated for the parent cohort. The author is however confident that those themes expressed by specialist educators working with DHH students were saturated, as no substantially different codes were needed to explain respondent data following the first focus group. Key themes were identified using a structured process where concepts were examined for how frequently they occurred in the data, and for the range of respondents who had referenced the concepts in interviews and focus groups. Triangulation methods such as ideation activities and the persona validation workshop further supported data saturation. Future research could examine the parental perspective in more depth, by larger and more diverse sampling.

Recruitment and Remote Interviews

The recruitment process was lengthy, and at times, it was difficult to know how to reach potential respondents. Given the high specificity required of respondents, it would have been ideal to conduct focus groups in a range of New Zealand cities to allow participants in other locations to attend the sessions. The author assumed that allowing respondents to participate in interviews remotely via Skype would be preferable to interviewees, however due to internet connectivity, microphones and monitoring recording equipment, rapport building was somewhat diminished. Having in-person interviews in addition to the focus groups and remote interviews might have helped with this rapport building, especially with respondents who may not regularly use Skype or video chat mediums.

Respondents

When talking with respondents, the author found that those students who tended to do well appeared supported by their parents, had strong interests, had stable friendships and in the case of a satellite class for the Deaf, were prepared for times of transition (for example from primary school to secondary school) due to knowing d/Deaf peers. Similar contributing factors were identified by Luckner and Muir, who found ten themes that contributed to Deaf students' success (Luckner & Muir, 2002). Teachers of the Deaf described expectations being in line with the student's performance however, not necessarily the 'high expectations' mentioned by Luckner and Muir. A strong grounding in language skills and vocabulary was discussed by educators in focus groups when asked about social skills, as were explicit and 'pre-teaching' strategies. Parent respondents who were involved in the research described their children's language at a level relatively appropriate for their age, so are likely not representative of those students who may be struggling most in social skills areas. Further research could also explore the themes described in this thesis with DHH students themselves, as though rich information was gained educators and parents are still a proxy for the DHH students themselves.

Future Work

Possibilities for future research are described in this section. These include further collection of primary data from parents and mainstream educators, evaluating the proposed intervention with students, and conducting long-term effect trials to determine intervention efficacy.

Extended Collection of Primary Data

As mentioned earlier, data was not fully saturated for parents. The variability in student success rates can be partly attributable to family dynamics and personal strategies used by DHH students, so the author believes it worthwhile conducting further research in this area, with parents from a range of regions, socio-economic backgrounds and ethnicities. Gaining the perspective of mainstream educators would also be valuable, as these educators are the individuals most likely to have substantial 'face time' with DHH students. Investigating how educators use digital resources in this area would be of benefit to not only this intervention and its use in classrooms, but to others seeking to deploy education-technology applications. It would be interesting to examine the practicalities of how educators manage resources in this area, for example their allocation of devices to students during class-time. Further, seeing how educators integrate DHH students into their classrooms, and existing strategies educators have used to enable this might provide insight for other educators.

Usability Study with DHH Students

This study utilised a range of methods in the collection of primary data, including observation, SME consultations, interviews, co-design activities, focus groups and evaluation workshops. Though specialists have domain expertise of DHH students,

they are still a proxy for these individuals. As such, the author recommends usability studies with d/Deaf and Hard of Hearing individuals once an interactive intervention prototype has been developed. Such a study could examine student's use of the intervention by way of screen-recording software, while concurrently asking the student to 'think aloud' about their gameplay experience. Alternatively, qualitative interviews could be conducted following use of the prototype intervention in combination with screen tracking. This might provide indications as to usability elements to address while gaining valuable insight from participants about the meaning they gain from the system. It could also be worthwhile to explore a
A range of technology platforms for their usability with the DHH cohort. Respondents mentioned a range of devices and mediums, and there could be potential for VR-based interventions in this area, as one educator discussed during a focus group. Considering the efficacy of VR interventions for students with ASD, it is possible similar interventions for DHH students could be viable and useful for modelling specific scenarios students may encounter. This could be particularly beneficial in preparing students for transition periods, for example between secondary school and employment or tertiary education. Further, VR could offer an opportunity to develop empathy and training of people working with and being educated alongside DHH students, as its highly experiential and sensory nature could help with conveying other's experiences and develop empathy, as suggested by Glover's work in this area (Glover, 2017).

Intervention trials to determine efficacy

In the long-term, it is hoped that the intervention could be evaluated to assess if exposure to using it correlates with improvements in the identified areas of social

skills and pragmatics. Specialist educators could potentially utilise resources such as the School Social Behaviour Scales developed by Merrell to evaluate pre and post scores to ascertain if changes have occurred as a result of using the intervention (Merrell, 2002).

CHAPTER 6: USER EXPERIENCE AND DESIGN RECOMMENDATIONS

The themes from interviews and focus groups described in the findings chapter informed the design recommendations presented in this chapter. Design recommendations take the form of artefacts and advice for the user experience elements of the intervention, with the recommendations for game scenes and mechanics presented towards the end of the chapter. An SME who held a role as a speech language pathologist assessed Personas and Context Scenarios during a remote workshop conducted via video conferencing in addition to recommendations provided over email.

PERSONAS

Primary and Secondary personas were designed based on the findings from focus groups and interviews. Personas are detailed in the following pages. The persona construction process was undertaken following the advice of Goodwin (Goodwin, 2005) and Cooper (Cooper, 2014), who recommend focusing on users behaviours, goals and challenges and how these might be addressed at a high level.

The data gathered indicated that there were patterns in the following areas for the primary persona, as described by educators and parents around the experience of DHH students. The persona and scenario artefacts were shared with an SME for triangulation purposes (Kolb, 2012). The primary persona and scenario documents pictured in this section are those validated by this domain expert.

Patterns observed regarding DHH students discussed by respondents:

1. Passive participation, even where the student is described as academically successful

2. Family background: hearing parents who may not communicate with the DHH child using NZSL
3. May have infrequent exposure to Deaf role models and DHH peers
4. As most DHH students are educated in mainstream environments in New Zealand, these students may feel like the only one 'like them'
5. Relationships with hearing adults – the DHH student may have experienced lower or unrealistic expectations from some adults in their life
6. Often experience comments from curious peers about their hearing supports, for example in relation to their hearing aids and cochlear implants
7. Typically struggle in areas of conversational repair, for example may not employ effective strategies around asking others to repeat or rephrase things
8. Vocabulary may be delayed and there may be 'gaps' in language and its usage in social contexts, for example relating to the multiple meanings of words, idioms and hyperbole
9. May struggle with emotion recognition and management in themselves and recognizing other's emotions
10. Will often 'smile and nod' rather than employ self-efficacy and self-advocacy strategies, possibly due to not wanting to feel more conspicuous or because of past experiences with hearing peers

11. May struggle with social nuance, for example interpreting social cues, facial expressions and body language

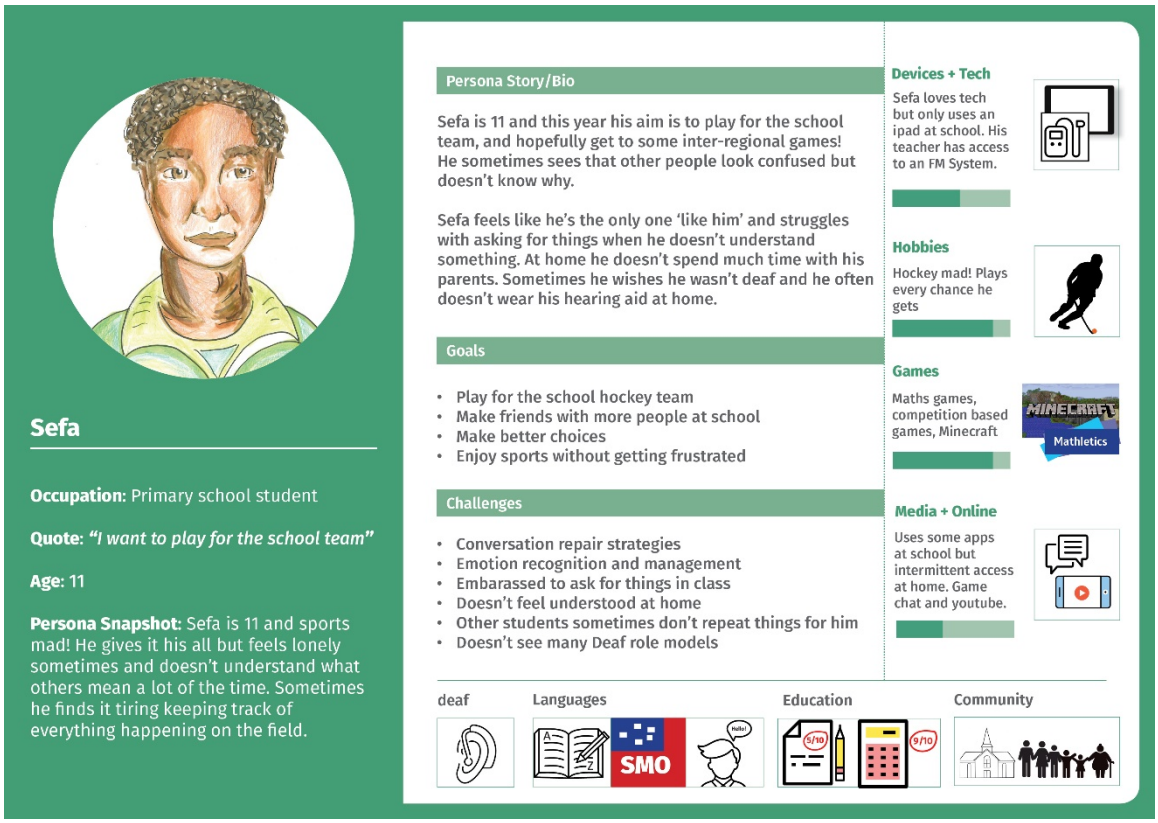


Figure 8: Primary Persona: Sefa.
[Images pictured at the bottom and right of the page have been adapted from purchased stock images. Minecraft image sourced from https://www.flickr.com/photos/bagogames/12844824643/in/photostream/ under a creative commons attribution 2.0 generic license]

Primary Persona: Sefa (11 year old Primary School student)

The primary school student persona of Sefa was based on a wealth of data from educator respondents. When asked about their students who might be facing social communication challenges, educators often described a pattern where the student may have difficulty with emotion recognition and management, be behind with vocabulary, struggle interacting with their hearing peers and have a lack of skills around conversational repair and lack confidence for asking for what they need. Further, educators intimated that there may sometimes be limited learning going on at home, and students may arrive at school with little in the way of communication skills

to prepare them for the school environment. Though educators worked actively with students on these, arriving at primary school with little knowledge gained through incidental learning places the student at a substantial disadvantage as the school and student plays catch-up. The Sefa persona represents an archetypical student who wants to feel included but may miss social nuance in conversations, and quite likely does not want to appear different to his hearing peers, a theme which parent respondents of deaf children described.

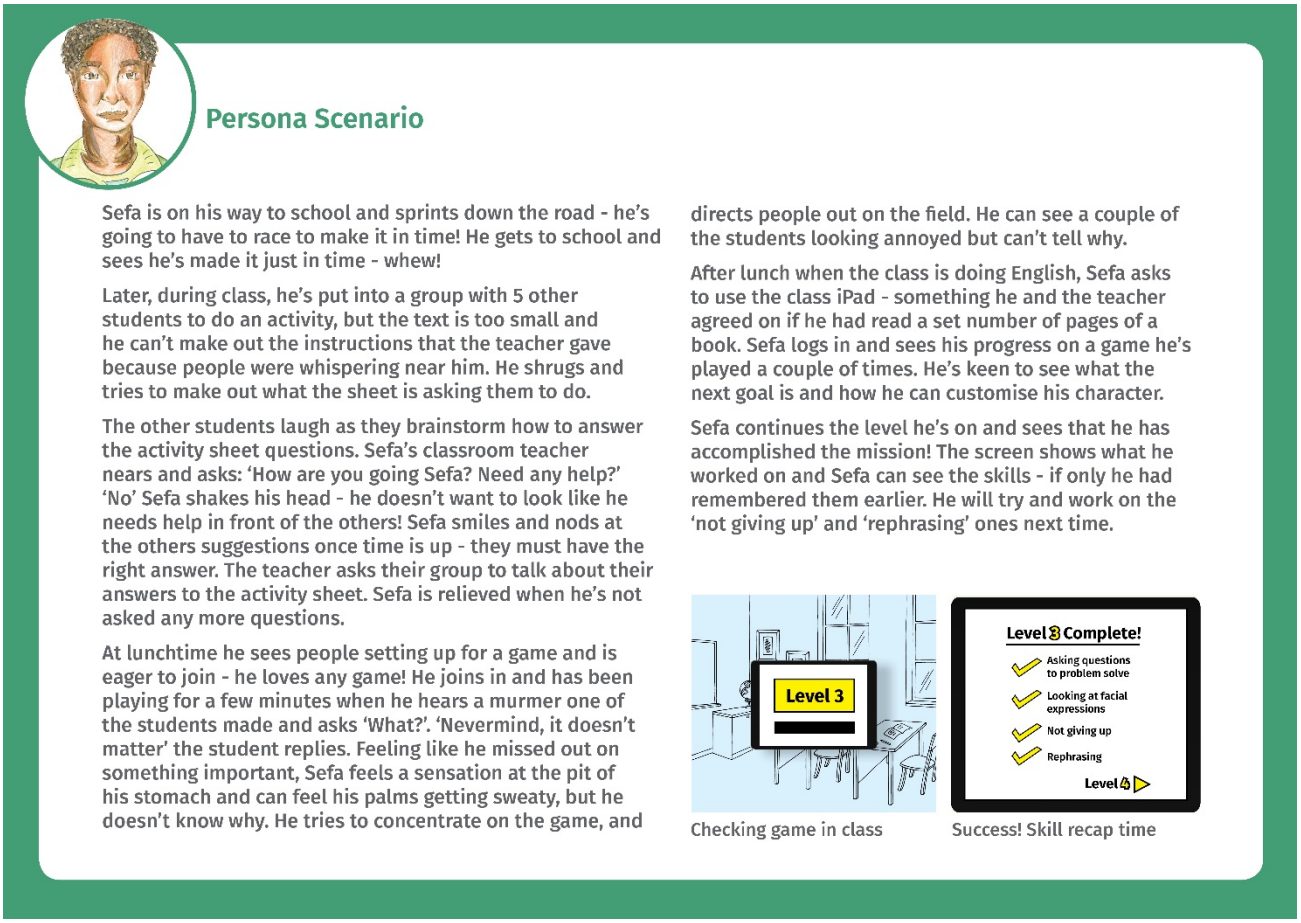


Figure 9: Primary Persona: Sefa Scenario.
[Images pictured to the right have been adapted from purchased stock images]

Primary Persona: Sefa Scenario

In this scenario, Sefa has a typical day at school where limited organizational, self-efficacy and self-advocacy skills as well as the contextual barriers imposed by the environment combine to create an overall experience of disconnection, passive rather than active participation, and limited understanding. For Sefa, having a form of learning where he doesn't feel singled out in a mainstream school environment may be optimal, as he may already feel conspicuous by virtue of hearing supports like his hearing aid and the FM system. Given Sefa's infrequent and limited exposure to Deaf role models, having these within an intervention in the form of characters or within scenarios could lay the foundation for feeling less stigma around his deafness. Teaching through scenarios that explicitly and clearly state the objectives or goals prior to the session and reiterate these through informational and clear feedback regarding performance further offer opportunities for review of the in-game learning content. As RTD respondents explained, teaching in a variety of ways, through different communication modalities and with many chances for review is often necessary to aid processing of learning material for their DHH students. Recommendations relating to possible game mechanics, user experience area and game scenarios that target the Sefa persona are presented at the end of this chapter.

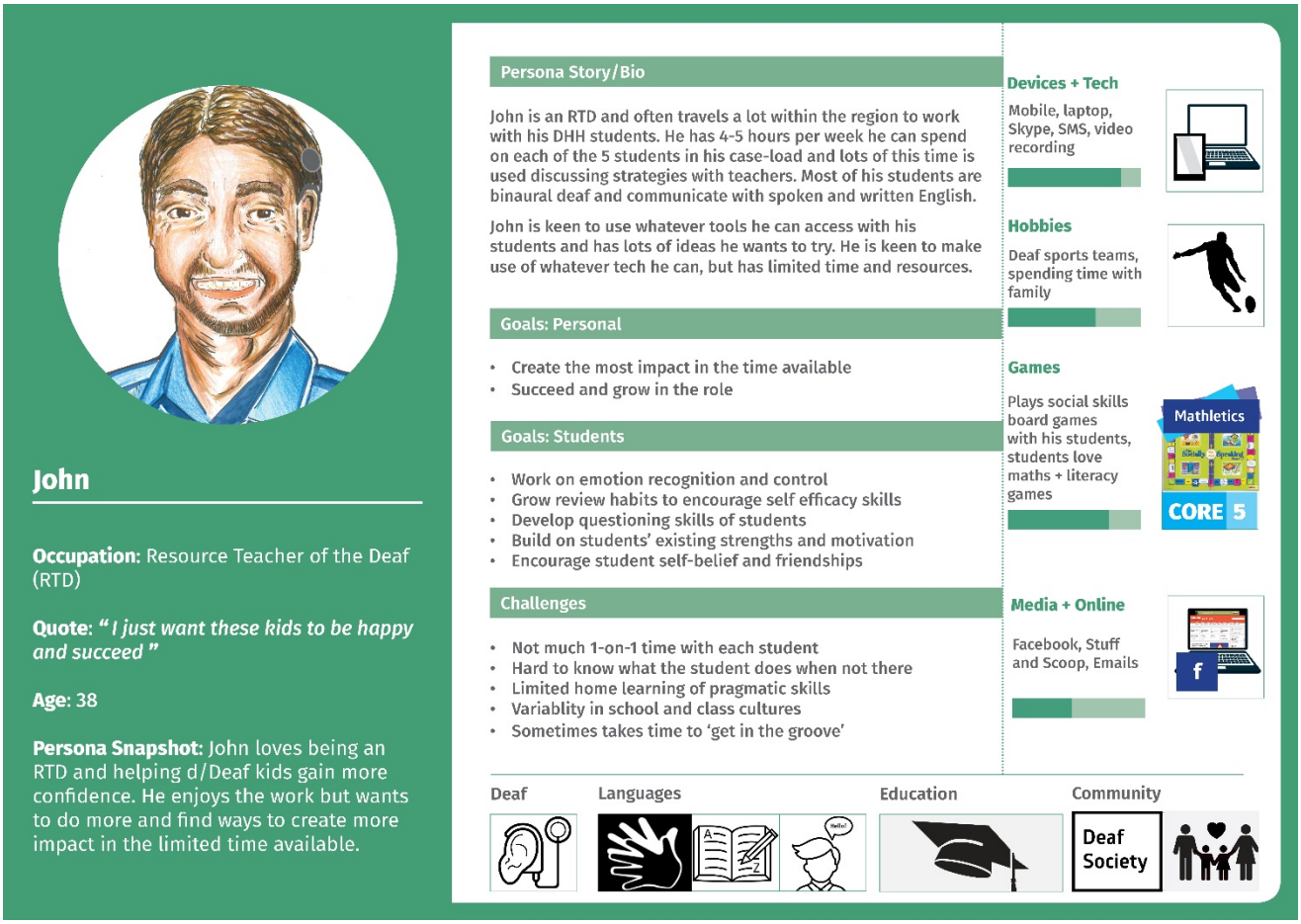


Figure 10: Secondary Persona John.
[Images pictured to the right and below have been adapted from purchased stock images]

Secondary Persona: John (Resource Teacher of the Deaf)

The secondary persona created was that of an RTD, due to the involvement of four RTDs in the interviews and focus groups and the wealth of data collected that indicated RTDs often worked the closest with students on social skills and pragmatics. This persona also represents insights collected from three Teachers of the Deaf however, given similar domain expertise and experience.

The response from the SME upon seeing the RTD persona was that she could "see this person". Though a Speech Language Therapist herself, she worked with RTDs

and provided detailed insights that helped refine the persona. Some suggestions made were in the following areas: clarity of Deaf section (i.e the differentiation between the 'types' of deafness); indicating which 'type' of English was used, for example spoken or written, and being clear and unambiguous. Some suggestions were further made regarding the experience of RTDs, specifically around a feeling of 'dislocation' due to working in a number of different school contexts and cultures, which the respondent said was highly variable between schools, classes and personality types. The domain expert who provided commentary regarding the secondary persona also said it would sometimes take educators time to 'get in the groove' of each school and class culture, a finding that was incorporated into the final persona as pictured.

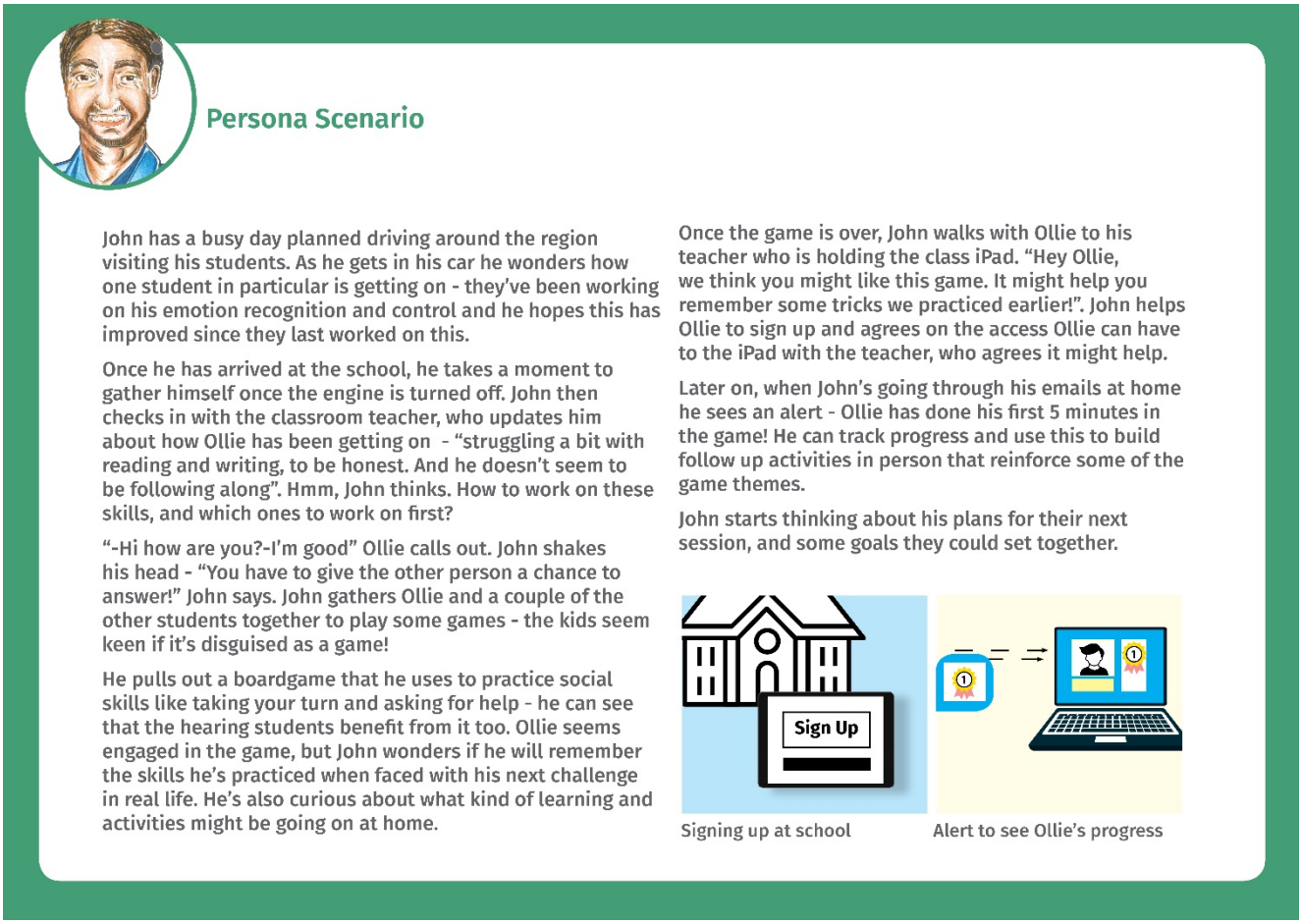


Figure 11: Secondary Persona John Scenario.
[Images pictured to the right have been adapted from purchased stock images]

Secondary Persona: John Scenario

In this scenario, John has a busy workday driving around the region working with the students on his caseload. The persona is particularly based on the experiences of four RTDs and three ToDs, though other specialist respondents contributed to it. Three of the RTDs who participated in the research were Deaf themselves, and so were able to offer a unique perspective on the experience of not only being an RTD, but also of growing up Deaf in New Zealand. RTDs often travel between diverse school settings to work with their students and collaborate with their student's teachers and are keen to leverage tools and resources with their students around areas of vocabulary and social skills. This was practically evidenced by the resources educators discussed using such as Socially Speaking and Sign Ninja (Schroeder, 1996) (Sign Ninja, 2018). Being mobile and with limited time available for each student, RTDs want to create impact in the time they do have, but may mainly be working with mainstream teachers. An intervention that could allow for tracking student progress during interim times between contact hours would likely offer a strong opportunity to build on social skills and pragmatics goals with students.

Note on Game Mechanics and User Experience Recommendations

The game mechanics and interface recommendations presented below are comprised of the synthesis of themes that emerged from respondents. They address the primary persona 'Sefa' and secondary persona 'John'. Several of the mechanics recommended add an extra reinforcement of pragmatics areas, such as 'choice' and 'visual feedback' to increase exposure DHH students have to problem solving and self-efficacy strategies.

GAME MECHANICS AND USER EXPERIENCE RECOMMENDATIONS

Interface and User Experience	Large black text captions on white background or the ability to enlarge text is recommended to support the main visual content. Based on recommendations by respondents regarding the intervention needing a high degree of interactivity, the interaction with the system should encourage active play through strategies like role-play and problem solving. This could include 'combos' such as checking hearing supports, utilising in-game objects, looking at the conversation partner's face, raising a hand, establishing contact by tapping someone's shoulder'. Gameplay could possibly include active searching or navigation within levels for tools that can advance player progress or goal attainment.
Levels and Calibration	To support player progress and feelings of competence. Levels should be easy enough to on-board students and work towards increasing competency and difficulty. The game system should respond to player progress and give the player opportunity to review their strategy or technique where appropriate.
Characters	Player representation and customization, Deaf role models by way of character design is recommended, including a diverse range of DHH characters of different ethnicities and who use a range of audiology devices.
Goals	Well-articulated goals, broken down into sub-goals or 'steps' are recommended based on the primary data. This is further supported by recommendations for 'Proximal' and 'Distal' goals articulated in the game literature (Ryan R. M & Rigby C. S., (in press)).

Reward	Engaging rewards for successful player strategies, such as picking up tools or items at the end of a level and being able to further customize character. The game system should provide feedback to the player promptly and with clarity, for example through points, rewards for levelling up, badges or progress bars.
Choice	Gameplay changes based on player choices, reinforcing feelings of competence, providing opportunities for review and strengthening concept of actions having consequences to develop problem solving skills and self-efficacy skills.
Interactivity	Reinforces interactive element of social skills practice, emphasising role-play elements. A high level of interactivity is recommended to improve the feeling that the player is authentically role-playing the experience of the particular social scenario.
Unlocking options	Player character could be rewarded with new tools to use in subsequent gameplay, creating a feeling of surprise and reward. This could further develop feelings of competence, self-efficacy and reward and support player engagement.
Visual feedback and Review	Clear, concise, and informational feedback on player performance, communicated to the player quickly. Specific information rather than general feedback. This could take the form of points attributable to a particular skill, so the player knows they are doing well in 'classroom skills concerning FM systems', but may need to put more work into 'emotion management skills in sports', for example. At the completion of a level, the player could be presented with a screen offering visual review of the skills covered in the level for additional reinforcement of level objectives. Alternatively, a progress bar could indicate how players are tracking towards a particular skill.
Graphics	Clear and engaging graphics to stimulate player interest, at an appropriate size that is easy to apprehend meaning and importance. Advice is to prioritise central components and for objects that are not central to the goal/s of the level to not have a large level of interactivity. Player attention and the key graphics should be in the centre of the game screen with limited distracting visual information in peripheral areas, as this could place a high level of cognitive load on the player.
Settings, Dashboards and Connectivity	Language (vocabulary) level settings could be helpful to address the varied vocabulary knowledge of players. Dashboard and synchronizing option for specialist educators such as RTDs and ToDs to monitor player progress is recommended.
Platform	iPads, medium- and large Android tablets or web-based systems that provide a consistent user experience across multiple devices. This recommendation is based on the high use of iPads within classroom

	environments in New Zealand and observed in respondent data. Future work could examine the possibility of mobile-phone compatibility given the high use of mobile devices by DHH adolescents, as described in focus group three.

Table 11: Game Mechanics and User Experience Recommendations

GAME SCENARIOS (SCENES)

The Game Scenarios presented in this section are primarily comprised of the codes within the thematic category of 'Contextual Barriers Scenario Inspiration' and 'Teacher Recommendations for the Game' created in NVivo, and which were based on patterns of recommendations and examples provided by parents and educators. As expressed in the results and discussion chapters, contextual barriers are barriers to communication that DHH students commonly experience which limit their ability for full and active inclusion in a great deal of social situations, events and contexts. The scenarios presented here are those that arose as themes in the analysed primary data.

Sports (Contextual Barriers, Cognitive load, Self-Efficacy, Self-Advocacy, Emotion Recognition)	Emotion recognition and management, reviewing your strategies, approaching adults about your needs, cognitive load, taking turns, suggesting accommodations or modifications, talking to coaches or captains about your deafness and inclusion in teams.
Out and About and Dining (Contextual Barriers, Conversational Repair and Social Cues)	Dining, shopping, repeating and rephrasing sentences, modelling social behaviours that are expected in situations like approaching a waiter, discussing your order.
Friendships (Friendship maintenance and Relationships with Hearing Peers)	Initiating conversation, maintaining relationships, asking questions to identify shared interests with hearing peers, humour, missing the punchline of a joke, opening up to others about your deafness, understanding communication differences between those you would have with a friend and those with an acquaintance, i.e 'what it means to be a friend', providing support, conventions around what is considered 'polite', strategies to deal with parties and the communication and cognitive challenges these impose
Standing up for Needs (Self-Efficacy and Self-Advocacy)	Persisting with clarification requests, being brave and asking for help, using part of what you've heard to fill in the gaps of what others' have said.
Goals (Self-Efficacy and Problem Solving)	Thinking about what you are good at and what you could work on, identifying strengths, taking steps towards goal attainment, breaking down goals into manageable steps.

Facial expressions and Body Language (Social-Emotional areas)	Recognising other's possible emotions based on their facial expressions, working backwards to see what might have caused a particular emotional reaction, looking at how others communicate beyond what they say, reading and inferring what people mean by their stance and posture.
Being prepared (Self-Efficacy and Self-Advocacy)	Letting others know your needs, organizing yourself where possible to limit the impact of unexpected situations such as being asked to introduce yourself without notice, having items required for learning ready such as hearing aids, cochlear implants and FM systems, asking for information ahead of time, working with educators to identify gaps in knowledge.
Employment (Self-Efficacy and Self-Advocacy)	Expectations employers have, articulating what your strengths are, practically explaining what would be required for your inclusion in the workplace, role playing the experience of attending a job interview or applying for a job, knowing expectations around time management and calling in sick, negotiation.
Transport (Self-Efficacy, Contextual Barriers and Problem Solving)	Conversations in the car, using public transport, asking for directions and what to do if you are lost, responding to bus and train drivers, finding places to sit, telling others you are d/Deaf and asking for accommodations...
School-wide events (Contextual Barriers and Cognitive Load)	Strategies to use when support people like familiar adults or peers might not be available, environmental challenges such as the sports field, pool, disco or school dance and theatre.
Classroom and Learning requests (Contextual Barriers, Conversational Repair, Self-Efficacy and Self-Advocacy)	Identifying communication barriers in the learning context such as lighting and the acoustic environment, seeking to resolve these, asking educators to use hearing accommodations such as FM Systems and provide supplemental learning materials, discussing note-taking needs with University staff and lecturers.
Group and team work (Conversational Repair, Self-Efficacy and Self-Advocacy)	Dynamics of working in a group or team situation, cognitive load inherent in following multiple speakers, advocating for oneself' in conversation, asking for resources to support information that may delivered verbally, speed of conversation
Health and Emergency (Contextual Barriers, Self-Efficacy and Self-Advocacy)	Talking to a General Practitioner, visiting a hospital, communicating with an audiologist, what to do in an emergency such as an earthquake or fire (suggested by focus group respondents)

Table 12: Possible Scenes

CHAPTER 7: CONCLUSION

A Summary of the key research findings and project is outlined in this chapter, and the broader limitations and opportunities of the research articulated. Answers to the research questions are summarised.

The first research question was *'How can we best design a digital social skills game for DHH students? What are some salient themes that emerge from the primary data that could be useful for designing digital social skills interventions for DHH students?'* To answer this research question the author examined the literature and consulted with domain experts to define key social skills areas to focus on during the primary data collection. The social skills and pragmatics areas originally identified by the author as important for the intervention were validated by a wealth of qualitative data from educator and parent respondents. These social skills and pragmatics themes were conversation repair; contextual barriers; self-efficacy and self-advocacy and Theory of Mind. Stigma had originally been included in the 'social skills and pragmatics' theme, however this was determined to better conform to the 'Identity, Culture and Relationships' theme due to the perceived relationship between the range of meanings attached to deafness and the identification of Deaf culture as a protective factor against students' internalizing of stigma. Additional emergent themes in the area of social skills and pragmatics raised consistently by respondents were social emotional learning, vocabulary skills to support communication, and communication modality, which would be important considerations for the future intervention.

The second research question was *'Who are the potential users and which characteristics are shared amongst respondents? Are there patterns of how DHH students communicate with others or what they might need in this area? What are user's goals and motivations?'* This research questions was concerned with the users of the intervention and patterns of behaviour, goals and experience. Patterns of DHH students in this area included passive participation, likely limited exposure to DHH peers and limited exposure to effective communication strategies due to fewer incidental-learning opportunities. Further themes were difficulties in conversation repair, for example in persisting with clarification requests despite a hearing peer's reluctance to repeat a phrase. This was a common experience for DHH students, including those described as academically moderate to high achieving.

Students described by educators as in high need would often present at school with generally limited social communication skills. These DHH students were further described as having limited home learning opportunities. Strategies that educators described as helping students make up for gaps in their social communication learning were explicit teaching of things like conversation strategies, social cues and perspective taking through role play. Further, respondents suggested that opportunities to connect with the Deaf community are important for students, as this can help DHH children and youth feel like there are others 'like them', which is particularly important when contemplating that the vast majority of DHH students are educated in mainstream environments, both in New Zealand and internationally. Educators recommended more exposure to positive Deaf role models and discussed 'Keeping in Touch Days' and NZSL groups as places and events where DHH students could connect with Deaf peers and gain visibility to Deaf adults. Further recommendations were to portray a range of Deaf identities in the game, for example

Deaf characters with a range of ethnicities including Māori and Pacifica representation, especially as Māori and Pacifica individuals are highly represented in deafness figures in NZ. The research question was further answered in the creation of design artefacts such as personas, context scenarios and proposed game scenarios that describe 'scenes' that DHH players could role play within a future game-based intervention. The primary persona of 'Sefa' describes a deaf student whose challenges include emotion recognition, conversation repair and advocating for his needs. The Sefa persona was based on substantial themes collected through interviews and focus groups and was further informed by Ministry of Health data. A secondary persona 'John' was designed to describe secondary users of the intervention, and was informed by the experiences of Resource Teachers of the Deaf and Teachers of the Deaf, who formed a large proportion of the respondents involved in interviews and focus groups, and who work closely with DHH students in areas of language and communication. Patterns in this area were that these educators can face challenges navigating varying school, class and educator cultures and have limited in-person time with their DHH students and that they often work closely with mainstream educators of DHH students. The author proposes that dashboard functionality in the intervention could leverage RTD and ToD resources effectively, by allowing remote educators to track student progress and work on reinforcing in-game social skills concepts in their contact sessions with students.

The third research question was concerned with discovering game and user experience themes and recommendations. The question to be answered was *'What would an intervention in this area require in order to be effective and desirable, according to parents and educators? What are the recommendations and experiences*

of educators and parents?' The prevalent concepts connected to this research question were age, characters, consolidation games, game mechanics, games played by educators and students, user experience of games, applications and devices, games and applications used by DHH students and teacher recommendations for the game-based intervention. Game mechanics that were frequently recommended by respondents were: goals that were broken down into steps or smaller goals, levels and progression, fast, clear and informational feedback, choice and consequences for choice, visual reinforcement, and reward to support player motivation,

Character recommendations largely centered on including a variety of ethnicities and 'types' of Deafness in the character design. For example, Māori and Pacifica characters with some variation around the types of hearing supports used such as hearing aids, cochlear implants and FM Systems. In terms of the age of players who might be most benefited from the intervention, the author recommends focusing on DHH students who are approaching times of transition, for example older primary school students and secondary students. This is due to the probability that these students will need to express their communication requirements to new people and will likely experience a range of contextual and conversational barriers.

User experience and interface recommendations included clearly worded captions with high contrast for legibility, having a simple login process, the intervention working well on guided access, clear goals communicated to the player, and visual reinforcement of reward and provision of choice to reinforce problem solving behaviours. Educators also discussed the possibility of future NZSL use in the game to promote access to Deaf culture and bilingual skills. The 'Minimum Viable Product' first version of the intervention could address the complexity in communication modality by use of respondents' suggestions of clear visual communication

supplemented with concise captions. Educator respondents recommended the intervention be as “contextual and authentic as possible” and frequently mentioned high interactivity as a way to achieve this, so students could engage in experiential role-play of social skills and pragmatics strategies and transfer game content to various social contexts.

The final research question focused on investigating the literature using a systematic literature search process of digital interventions designed for the purposes of social skills training for ASD and DHH students. As previously articulated, there is a dearth of research regarding technology-based social skills and pragmatics interventions for d/Deaf individuals. This gap in the literature warranted an investigation of work done in other fields for similar social skills purposes to explore the applicability of key lessons from ASD research for DHH students. Though the aetiology of social skills deficits may be different between students with ASDs and DHH students, the deficits can present in similar ways, for example with deaf children of hearing parents and Autistic children often experiencing similar delays in their acquisition of Theory of Mind skills. The author therefore recommends incorporating some of the lessons from interventions designed for students with ASDs into the design of interventions for DHH students given the lack of any comparable technology-based interventions in the social skills and pragmatics areas for DHH students.

Limitations of the research concern the small cohort of parent respondents, despite the author’s best efforts to recruit nationally. It would be worthwhile conducting more extensive research with a range of parent respondents from different socio-economic,

ethnic and geographical backgrounds. A wealth of data was gained from educators and these respondents had significant domain expertise regarding DHH students. However, the strength of the research could be improved by larger sampling of mainstream educators. Finally, more active involvement of d/Deaf and hard of hearing students themselves in research of this nature would increase triangulation opportunities and offer insights for the intervention effort.

Future research efforts should seek to test an interactive prototype in the aforementioned areas of social skills with representative DHH users. This would help to ascertain appropriate vocabulary and difficulty levels for the intervention. In the long-term, testing of the efficacy of the intervention in bringing about improvements in the identified social skills areas is required to create the most impact for d/Deaf students. More active involvement of DHH students in future research efforts is recommended and this would no doubt provide deeper insight.

Results of the research effort presented in this thesis were identified social skills, communication and pragmatics areas that were validated with respondents who had substantial domain expertise and specific design recommendations that took the form of personas, scenarios, user experience recommendations and proposed scenes for the game-based intervention. Triangulation processes led the author to be confident that the concepts emerging from collected data were representative of widely experienced patterns. Ideation prompts created by the author further offered methods that supported co-design activities with focus group respondents and allowed for the collection of rich qualitative and visual data. Personas and scenarios were verified with a domain expert who expressed that these artefacts could be beneficial in their

education practice and that such visual tools display respect for representing information visually, an inherent part of Deaf culture.

The original contributions of the author are the following:

1. The combination of methods common in qualitative grounded theory research with a human-centered and goal-directed design framework to uncover social skills and pragmatics areas relevant to d/Deaf and Hard of Hearing students that a digital game-based intervention could target
2. Identification of patterns of experience and behaviours that informed the design of personas and scenarios to aid future intervention development
3. Research support tools designed by the author for effective qualitative data gathering in the form of ideation prompts
4. User experience and design recommendations, and high level recommendations for game scenarios to model social situations
5. Identification of a clear gap in the field of technology-based social skills and pragmatics interventions for DHH students, following a rigorous systematic literature review process that demonstrates that no similar work has been undertaken to date, and uncovering the potential application of technology-based interventions developed for children with Autism Spectrum Disorders for DHH students.

There is a great deal of potential in the area of technology-based social skills interventions for DHH students. The author hopes the research presented in this thesis leads to an effective and engaging intervention that can help to develop the field and has a real world positive impact for d/Deaf and hard of hearing students. As shown in

this thesis there is a fundamental lack of appropriately researched interventions and the need to support d/Deaf and hard of hearing students is clearly high.

REFERENCES

Adams, A., & Cox, A. L. (2008). *Questionnaires, in-depth interviews and focus groups*. Cambridge, UK: Cambridge University Press.

Aldiabat, K. M., & Le Navenec, C.-L. (2018). Data Saturation: The Mysterious Step In Grounded Theory Method. *The Qualitative Report, 23*(1), 19.

ATLAS.ti. (2018). ATLAS.ti: The Qualitative Data Analysis & Research Software: Scientific Software Development GmbH. Retrieved from https://atlasti.com/files/2100/atlasti.com.html

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122-147. doi:10.1037/0003-066X.37.2.122

Bandura, A. (1985). *Social Foundations of Thought and Action: A Social Cognitive Theory* (1 edition ed.). Englewood Cliffs, N.J: Prentice Hall.

Bat-Chava, Y. (2000). Diversity of Deaf Identities. *American Annals of the Deaf, 145*(5), 420-428. doi:10.1353/aad.2012.0176

Beal-Alvarez, J., & Cannon, J. E. (2014). Technology Intervention Research With Deaf and Hard of Hearing Learners. *American Annals of the Deaf, 158*(5), 486-505.

Berndsen, M., & Luckner, J. (2012). Supporting Students Who Are Deaf or Hard of Hearing in General Education Classrooms: A Washington State Case Study. *Communication Disorders Quarterly, 33*(2), 111-118. doi:10.1177/1525740110384398

Billard, A. (2003). Robota: Clever toy and educational tool. *Robotics and Autonomous Systems, 42*(3-4), 259-269. doi:10.1016/s0921-8890(02)00380-9

Birks, M., & Mills, J. (2015). *Grounded theory: A practical guide*: Sage.

Bowen, G. A. (2008). Naturalistic inquiry and the saturation concept: a research note. *Qualitative Research, 8*(1), 137-152. doi:10.1177/1468794107085301

Charmaz, K. (2005). *Grounded theory: Methods for the 21st century*. London: London: Sage.

Church, A., Paatsch, L., & Toe, D. (2017). Some trouble with repair: Conversations between children with cochlear implants and hearing peers. *Discourse Studies, 19*(1), 49-68. doi:10.1177/1461445616683592

Cipollone, M., Schifter, C. C., & Moffat, R. A. (2014). Minecraft as a Creative Tool: A Case Study. *Int. J. Game-Based Learn., 4*(2), 1-14.

Cole, R., Van Vuuren, S., Pellom, B., Hacioglu, K., Ma, J., Movellan, J., . . . Yan, J. (2003). Perceptive animated interfaces: First steps toward a new paradigm for human-computer interaction. *Proceedings of the IEEE, 91*(9), 1391-1404. doi:10.1109/JPROC.2003.817143

Cooper, A. (2014). *About face: the essentials of interaction design* (Fourth ed.). Indianapolis, Indiana: Wiley.

Corbin, J. M., & Strauss, A. L. (2008). *Basics of qualitative research: techniques and procedures for developing grounded theory* (3rd ed.). Los Angeles, Calif: Sage Publications, Inc.

De Lope, R. P., Medina-Medina, N., Montes Soldado, R., Mora Garcia, A., & Gutierrez-Vela, F. L. (2017). *Designing educational games: Key elements and methodological approach*.

Deci, E. L., & Ryan, R. M. (2008). Self-Determination Theory: A Macrotheory of Human Motivation, Development, and Health. *Canadian Psychology/Psychologie canadienne, 49*(3), 182-185. doi:10.1037/a0012801

Delaney, J. (2018). Researchers are using Minecraft to provide virtual mentoring for deaf teenagers. *Techly*. Retrieved from Techly website: https://www.techly.com.au/2018/10/02/researchers-using-minecraft-provide-virtual-mentoring-deaf-teenagers/

files/2091/researchers-using-minecraft-provide-virtual-mentoring-deaf-teenagers.html

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, 2011). *From game design elements to gamefulness: defining "gamification"*.

Edmonds, W. A., & Kennedy, T. D. (2013a). *An applied reference guide to research designs: quantitative, qualitative, and mixed methods*. Thousand Oaks: SAGE Publications.

Edmonds, W. A., & Kennedy, T. D. (2013b). *An applied reference guide to research designs: quantitative, qualitative, and mixed methods*. Thousand Oaks: SAGE Publications.

Epic Games. (2017). Fortnite (Version Windows, Mac OS, Nintendo Switch, Playstation 4, Xbox One, iOS, Androil): Epic Games.

Field, S., Council for Exceptional Children. Division on Career, D., & Transition. (1998). *A practical guide for teaching self-determination*. Arlington, VA: Council for Exceptional Children.

Figueras, B., Edwards, L., & Langdon, D. (2008). Executive Function and Language in Deaf Children. *Journal of Deaf Studies and Deaf Education, 13*(3), 362-377.

Fitzgerald & Associates. (2000). *A Survey of the Educational Needs of Deaf Children*. Retrieved from Wellington:

Frith, C., & Frith, U. (2005). Theory of mind. *Current Biology, 15*(17), R644-R645. doi:10.1016/j.cub.2005.08.041

Gennari, R., Pavani, F., & Rizvi, M. (2017, 2017). *Tangible design for inclusive conversations with deaf or hard-of-hearing children*.

Giacomin, J. (2014). What Is Human Centred Design? *The Design Journal, 17*(4), 606-623. doi:10.2752/175630614X14056185480186

Gibbons, E. M. (2015). Supporting Deaf and Hard-of-Hearing Students in the Schools. *Contemporary School Psychology, 19*(1), 46-53. doi:10.1007/s40688-014-0039-1

Glaser, B. G. (1978). *Advances in the methodology of grounded theory: Theoretical sensitivity*: Mill Valley, CA: Sociology Press.

Glaser, B. G. (2016). The Grounded Theory Perspective: Its Origins and Growth. *Grounded Theory Review: An International Journal, 15*(1).

Glaser, B. G., Strauss, A. L., & Strutzel, E. (1968). The discovery of grounded theory; strategies for qualitative research. *Nursing research, 17*(4), 364.

Glover, B. (2017, 2017/10/19/T19:55:51.593Z). Building a Deaf VR Experience. Retrieved from https://medium.com/@cyport/building-a-deaf-vr-experience-81d9f9b1d68d

Goodwin, K. (2005, 2005/01/13/T04:00:00+00:00). Perfecting Your Personas. Retrieved from https://articles.uie.com/perfecting_personas/

files/2049/perfecting_personas.html

Gould, J., & Lewis, C. (1985). Designing for usability: key principles and what designers think. In (Vol. 28, pp. 300-311): ACM.

Gubrium, J. F. (2012). *The Sage handbook of interview research: the complexity of the craft* (2nd ed.). Thousand Oaks: SAGE.
Holton, J. A. (2007). The SAGE Handbook of Grounded Theory. In A. Bryant & K. Charmaz (Eds.), The SAGE Handbook of Grounded Theory (pp. 265): SAGE Publications Ltd. Retrieved from http://methods.sagepub.com/book/the-sage-handbook-of-grounded-theory (2011). doi:10.4135/9781848607941
Ida Institute. (2018). My World. Retrieved from https://idainstitute.com/tools/my_world/
IDEO. (2015). *The field guide to human-centered design: design kit* (Ideo Ed. 1st. ed ed.). San Francisco, Calif: IDEO.
Izzo, M., & Lamb, M. P. (2002). Self-Determination and Career Development: Skills for Successful Transitions to Postsecondary Education and Employment 5-6.
Jambor, E., & Elliott, M. (2005). Self-esteem and Coping Strategies among Deaf Students. *Journal of Deaf Studies and Deaf Education, 10*(1), 63-81. doi:10.1093/deafed/eni004
Jones, A. C., Gutierrez, R., & Ludlow, A. K. (2015). Confronting the language barrier: Theory of mind in deaf children. *Journal of Communication Disorders, 56*, 47-58. doi:10.1016/j.jcomdis.2015.06.005
Kolb, S. M. (2012). Grounded theory and the constant comparative method: Valid research strategies for educators. *Journal of Emerging Trends in Educational Research and Policy Studies, 3*(1), 83.
Korte, J., Potter, L., & Nielsen, S. (2017, November 28 - December 01, 2017). *The impacts of deaf culture on designing with deaf children.* Paper presented at the OZCHI '17 Proceedings of the 29th Australian Conference on Computer-Human Interaction, Brisbane, Queensland, Australia.
Korte, J., Potter, L. E., & Nielsen, S. (2014). *Great expectations: what do children expect from their technology?* Paper presented at the SIGMIS-CPR '14 2014 Computers and People Research Conference, , Singapore
Krueger, R. A., & Casey, M. A. (2015). *Focus Groups: A Practical Guide for Applied Research* (5th ed. ed.). Los Angeles: SAGE.
Lexia Core5 Reading. (2015). Lexia Core5 Reading. Retrieved from https://www.lexialearning.com/products/core5
Luckner, J. L., & Muir, S. (2001). Successful Students Who Are Deaf in General Education Settings. *American Annals of the Deaf, 146*(5), 435-446. doi:10.1353/aad.2012.0202
Luckner, J. L., & Muir, S. (2002). Suggestions for Helping Students Who Are Deaf Succeed in General Education Settings. *Communication Disorders Quarterly, 24*(1), 23-30. doi:10.1177/152574010202400104
Luckner, J. L., & Sebald, A. M. (2013). Promoting Self-Determination of Students Who Are Deaf or Hard of Hearing. *American Annals of the Deaf, 158*(3), 377-386. doi:10.1353/aad.2013.0024
Malone, T. W. (1980). *What makes things fun to learn? heuristics for designing instructional computer games*. Paper presented at the Proceedings of the 3rd ACM SIGSMALL symposium and the first SIGPC symposium on Small systems, Palo Alto, California, USA. https://dl-acm-org.ezproxy.canterbury.ac.nz/citation.cfm?id=802839
Marschark, M., Walton, D., Crowe, K., Borgna, G., & Kronenberger, W. G. (2018). Relations of social maturity, executive function, and self-efficacy among deaf university students. *Deafness & Education International, 20*(2), 100-120. doi:10.1080/14643154.2018.1474330

McGonigal, J. (2011). *Reality is broken: why games make us better and how they can change the world*. New York: Penguin Press.
Merrell, K. W. (2002). *School Social Behavior Scales User's Guide*: Paul H. Brookes Publishing.
Michael, R., & Zidan, H. M. (2018). Differences in self-advocacy among hard of hearing and typical hearing students. *Research in Developmental Disabilities, 72*, 118-127. doi:10.1016/j.ridd.2017.11.005
Microsoft. (2018a). Minecraft Microsoft. Retrieved from https://minecraft.net/en-us/

files/2047/en-us.html
Microsoft. (2018b). Skype | Communication tool for free calls and chat. Retrieved from https://www.skype.com/en//

files/2105/en.html
Ministry Of Education. (2018). Supporting children who are deaf and hard of hearing Retrieved from http://www.education.govt.nz/school/student-support/special-education/supporting-children-who-are-deaf-and-hard-of-hearing/
Morse, J. M. (2015). Critical Analysis of Strategies for Determining Rigor in Qualitative Inquiry. *Qualitative Health Research, 25*(9), 1212-1222. doi:10.1177/1049732315588501
New Zealand Ministry of Health. (2008). *Pacific peoples' experience of disability: a paper for the Pacific Health and Disability Action Plan review*. Wellington, N.Z.: Ministry of Health.
Noll, D. (2007). Activities for social skills development in deaf children preparing to enter the mainstream. *Independent Studies and Capstones*.
Norman, D. A. (2004). *Emotional design: why we love (or hate) everyday things*. New York: Basic Books.
NVivo. (2018). NVivo, (Version Windows): QSR International. Retrieved from https://www.qsrinternational.com/nvivo/home
Peterson, C. C., & Siegal, M. (1999). Representing inner worlds: Theory of mind in autistic, deaf, and normal hearing children. *Psychological Science, 10*(2), 126-129.
Platt-Young, Z., Shahri, B., Hector, Z., Sutherland, D., & Hoermann, S. (2018). *Designing For The Deaf: The Potential Of Technology Supported Social Skills Training Interventions For D/Deaf and Hard Of Hearing Students.* Paper presented at the 12th International Conference on Disibility, Virtual Reality and Associated Technologies (ICVDRAT) Nottingham, UK.
Powell, D. (2011). *Floating in the Mainstream: New Zealand Deaf Students' Learning and Social Participation Experiences in Tertiary Education.* Griffith University,
Powell, D., & Hyde, M. (2014). Deaf Education in New Zealand: Where We Have Been and Where We Are Going. *Deafness & Education International, 16*(3), 129-145. doi:10.1179/1557069X13Y.0000000031
Putnam, C., Reiner, A., Ryou, E., Caputo, M., Cheng, J., Allen, M., & Singamaneni, R. (2016). Human-Centered Design in Practice: Roles, Definitions, and Communication. *Journal of Technical Writing and Communication, 46*(4), 446-470. doi:10.1177/0047281616653491
Reed, S., Antia, S. D., & Kreimeyer, K. H. (2008). Academic Status of Deaf and Hard-of-Hearing Students in Public Schools: Student, Home, and Service Facilitators and Detractors. *Journal of Deaf Studies and Deaf Education, 13*(4), 485-502. doi:10.1093/deafed/enn006

Riordan, B. C., & Scarf, D. (2016). Crafting minds and communities with Minecraft. *F1000Research, 5*, 2339. doi:https://dx.doi.org/10.12688/f1000research.9625.2

Roblox Corporation. (2018). Roblox. *ROBLOX.* Retrieved from https://www.roblox.com/

Ryan R. M, & Rigby C. S. ((in press)). *Motivational foundations of game-based learning*. Cambridge, MA: MIT Press.

Ryan, R. M., & Deci, E. L. (2000). Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being. *American Psychologist, 55*(1), 68-78. doi:10.1037/0003-066X.55.1.68

Sanders, E. B. N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *CoDesign, 4*(1), 5-18. doi:10.1080/15710880701875068

Savin-Baden, M., & Major, C. H. (2012). *Qualitative research: the essential guide to theory and practice*. Milton Park, Abingdon, Oxon;New York;: Routledge.

Schell, J. (2015). *The art of game design: a book of lenses* (Second ed.). Boca Raton: CRC Press.

Schoffstall, S., Cawthon, S. W., Tarantolo-Leppo, R. H., & Wendel, E. (2015). Developing Consumer and System-Level Readiness for Effective Self-Advocacy: Perspectives from Vocational Rehabilitation Counselors Working With Deaf and Hard of Hearing Individuals in Post-Secondary Settings. *Journal of Developmental and Physical Disabilities, 27*(4), 533-555. doi:10.1007/s10882-015-9435-3

Schroeder, A. (1996). *Socially speaking: a pragmatic social skills programme for pupils with mild to moderate learning disabilities*. Wisbech, England: LDA.

Sign Ninja. (2018). Sign Ninja - Learn NZSL Sign Language. *Sign Ninja.* Retrieved from http://www.nzslsignninja.co.nz/

Silverman, D. (2009). *Doing Qualitative Research: Amazon.co.uk: David Silverman: 9781848600348: Books* (3 ed.): Sage Publications Ltd. .

Stoker, R. G. (1983). A computer-assisted diagnostic and prescriptive tool for use in teaching speech to the deaf. *American Annals of the Deaf, 128*(5), 625-630.

Swanwick, R., Gregory, S., Daunt, W., Hanifin, J., & Silo, J. (2007). *Sign bilingual education: Policy and practice*: Douglas McLean Coleford.

Turner, A. M., Reeder, B., & Ramey, J. (2013). Scenarios, personas and user stories from design ethnography: Evidence-based design representations of communicable disease investigations. *Journal of Biomedical Informatics, 46*(4), 575-584. doi:10.1016/j.jbi.2013.04.006

Woods, M., Paulus, T., Atkins, D. P., & Macklin, R. (2016). Advancing Qualitative Research Using Qualitative Data Analysis Software (QDAS)? Reviewing Potential Versus Practice in Published Studies using ATLAS.ti and NVivo, 1994–2013. *Social Science Computer Review, 34*(5), 597-617. doi:10.1177/0894439315596311

Yoshinaga-Itano, C. (2015). The missing link in language learning of children who are deaf or hard of hearing: Pragmatics. *Cochlear Implants International, 16*(sup1), S53-S54. doi:10.1179/1467010014Z.000000000237

APPENDICES

A. Ideation prompts developed by the author and utilized by focus group respondents for the co-design segment of focus groups
B. ICDVRAT Conference paper, co-authored by Platt-Young, Hoermann, Sutherland, Shahri and Hector
C. Educational Research Human Ethics Approval Letter for Amendment
D. Educational Research Human Ethics Approval Letter
E. Educational Research Human Ethics Recruitment Poster
F. Educational Research Human Ethics Information Sheet and Consent Forms for Remote Interviews: Parents
G. Educational Research Human Ethics Information Sheet and Consent Forms for Remote Interviews: Teachers
H. Educational Research Human Ethics Information Sheet and Consent Forms for Focus Groups
I. Prospero protocol and registration for the Systematic Literature Review led by Platt-Young and Hoermann
J. Question prompts
K. NVivo code list of the thematic codes developed for primary data.

Appendix A: Ideation Prompts

Question:

What hobbies do your students enjoy? How could these be used for additional learning?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...

Spy novels
- write clues
- following sequences
- using interest to spark ideas for writing
- making resources related.

orienteering
- listening activities
- giving directions
- prepositions

Superheroes
- roleplaying
- pictures linked to language needs eg body parts / clothes

Animals
Link vocab

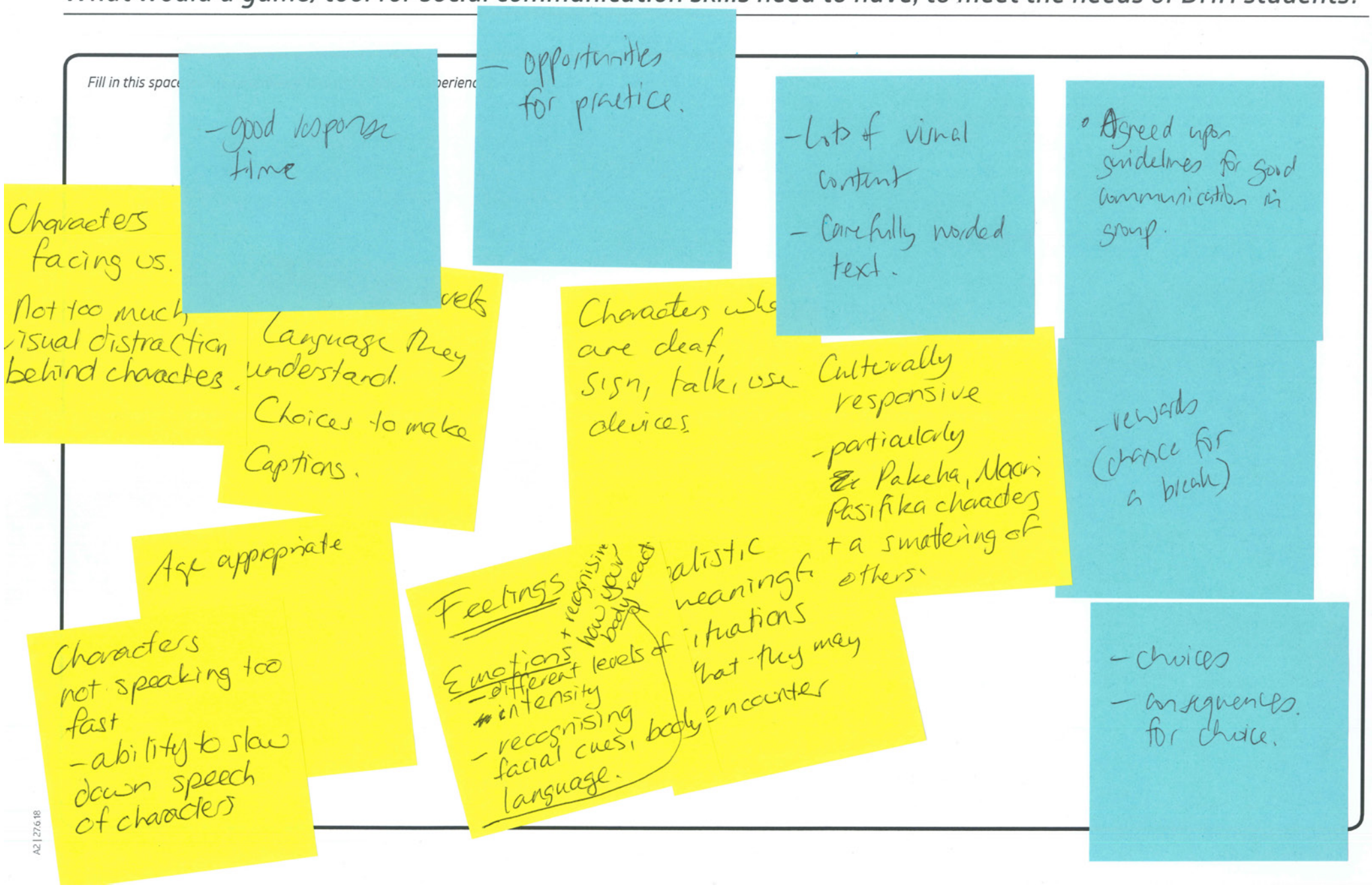
Lego (preschool/primary)
- barrier games
- positional language

Culture interests
- culturally responsive books

Sports
- deaf sports role models

Question:

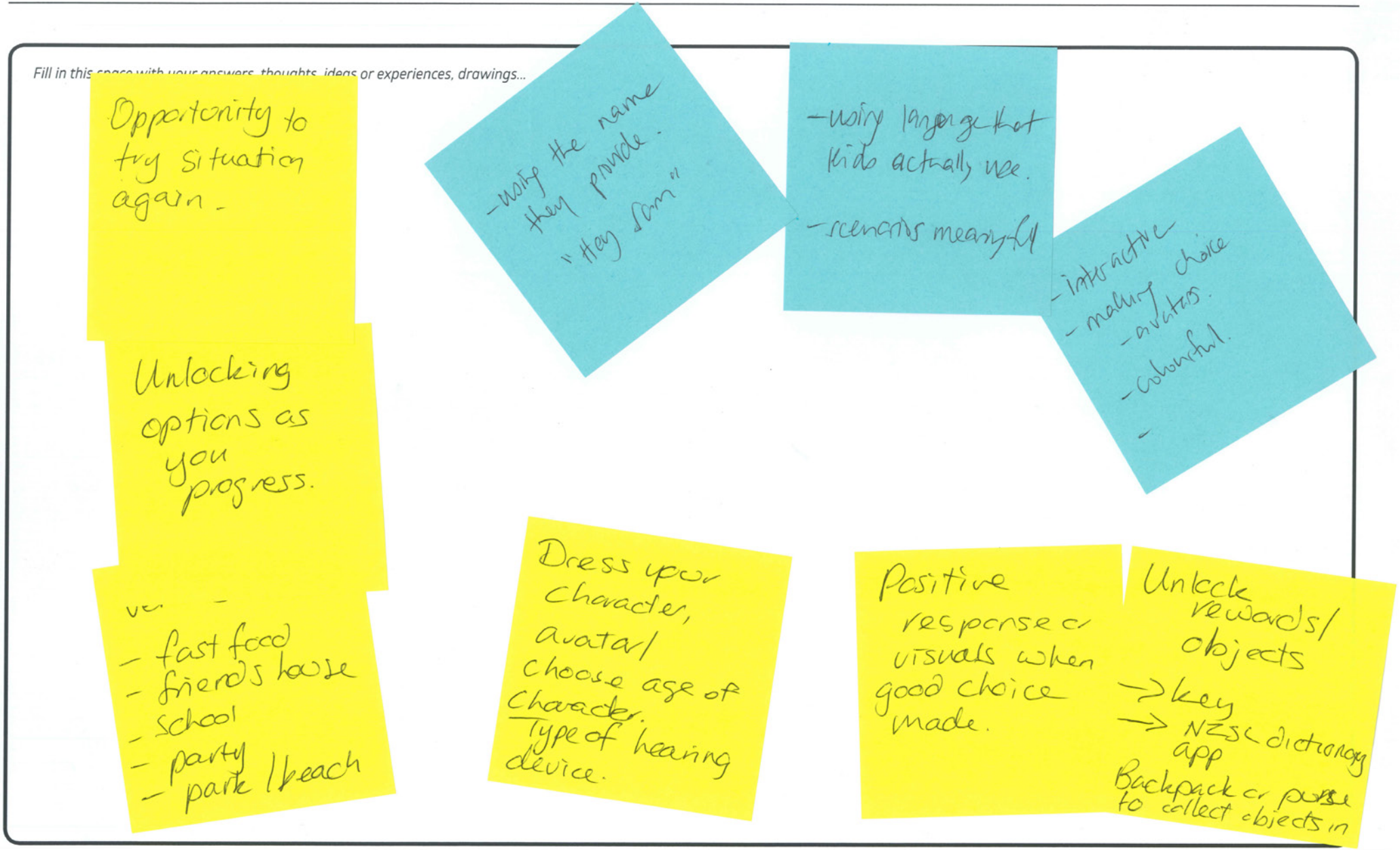
What would a game/tool for social communication skills need to have, to meet the needs of DHH students?



Question:

What would it need to have to be fun or enjoyable to use/play?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...



Question:

Media requirements for the game/app? What would it need to have & why?

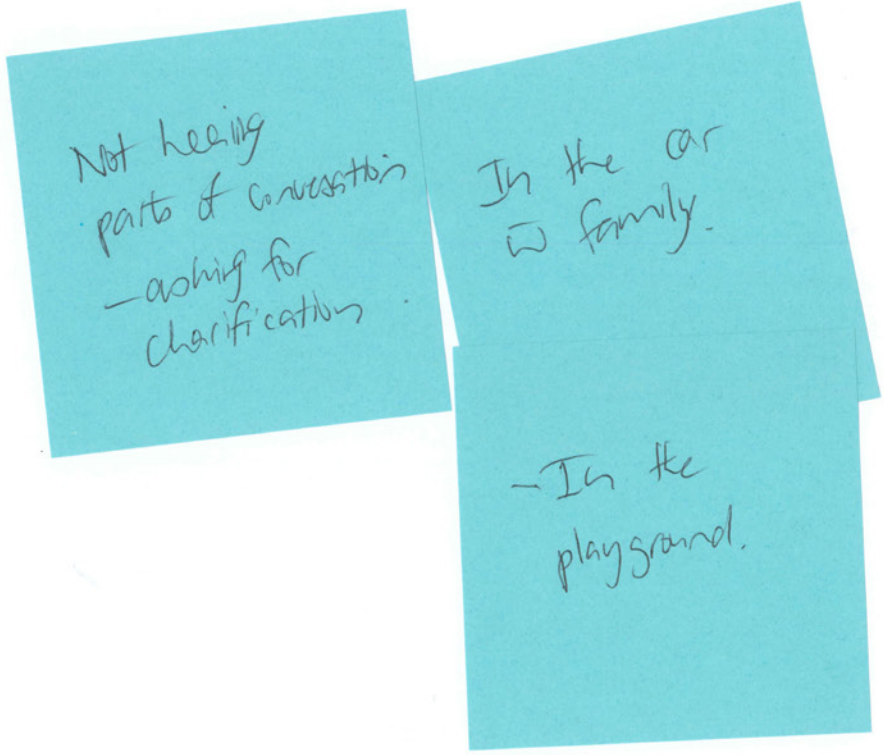
Fill in this space with your answers, thoughts, ideas or experiences, drawings...

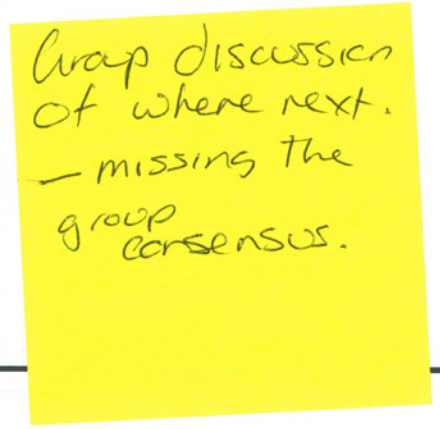
Different stages and levels of social skills. e.g higher level for High school

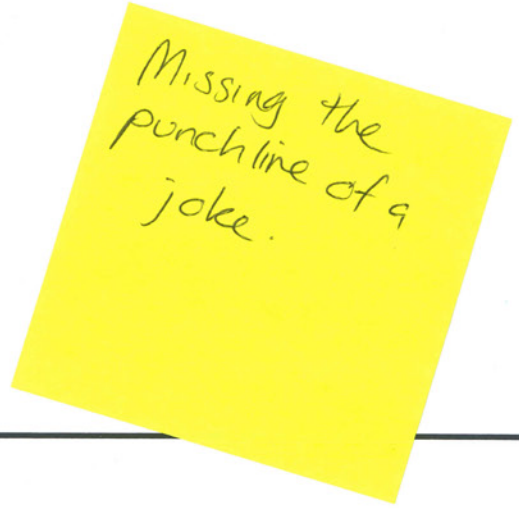
Question:

Scenarios - what scenes, situations or places would be helpful to include in the game?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...







Question:

What would success for your DHH students look like?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...

Question:

In an ideal world, what could the game/tool be or do?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...

Help students feel comfortable advocating for themselves.

Students playing with other students eg both have a device and they can see eachothers avatars.

Question:

What hobbies do your students enjoy? How could these be used for additional learning?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...

Make believe
- Frozen
- Moana

Sports (x2)
- rugby
- soccer
- b'ball

netball -
rugby -
soccer -
basketball

Karate
Music - listening to, playing piano

Family (sharing)

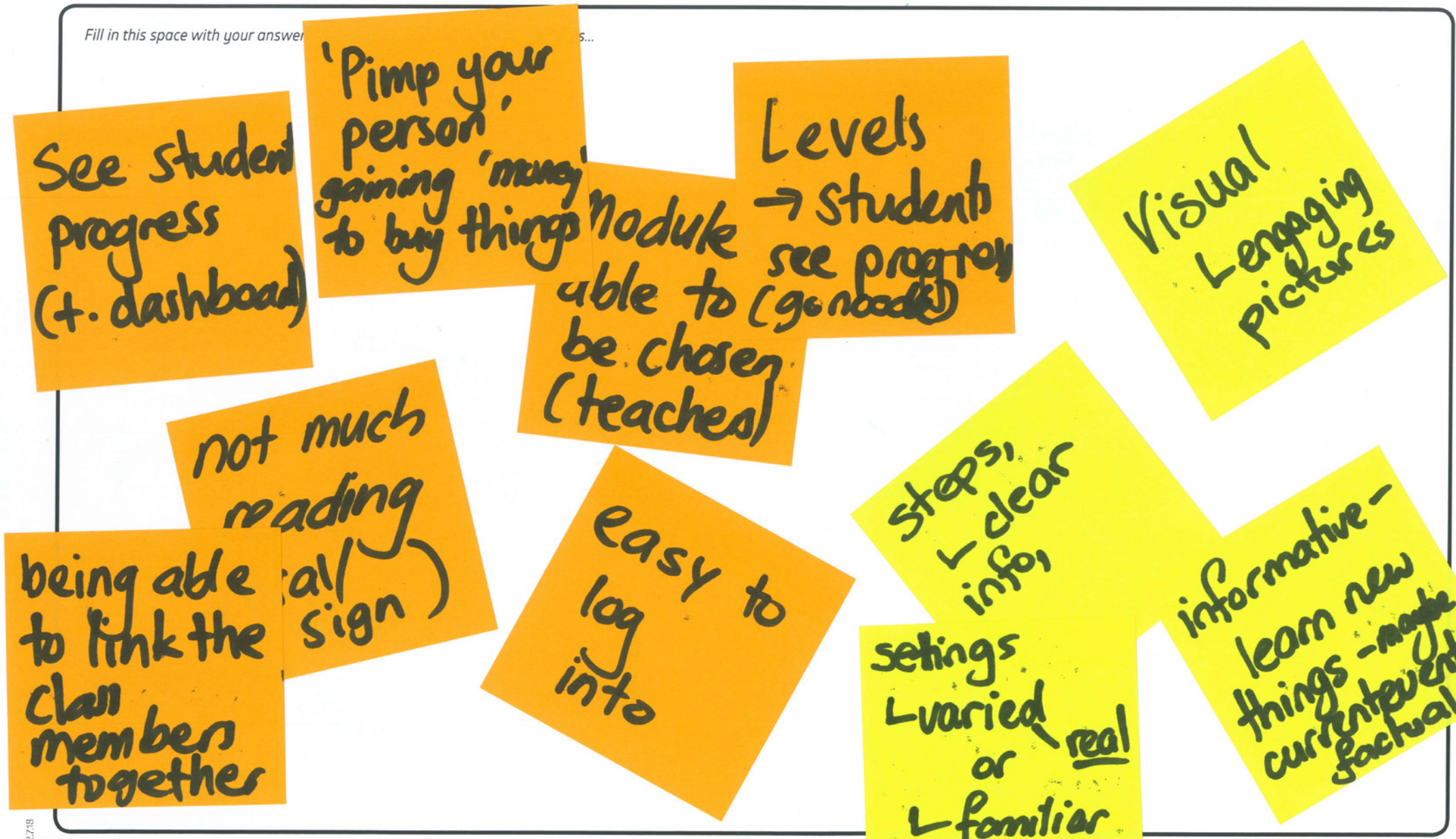
Drama
role plays

Martial arts

Crusaders
Lvisual connections

Question:

What would a game/tool for social communication skills need to have, to meet the needs of DHH students?



Question:

What would it need to have to be fun or enjoyable to use/play?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...

Question:

Frustrating situation - what would the response be? What might help or hurt?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...

Question:

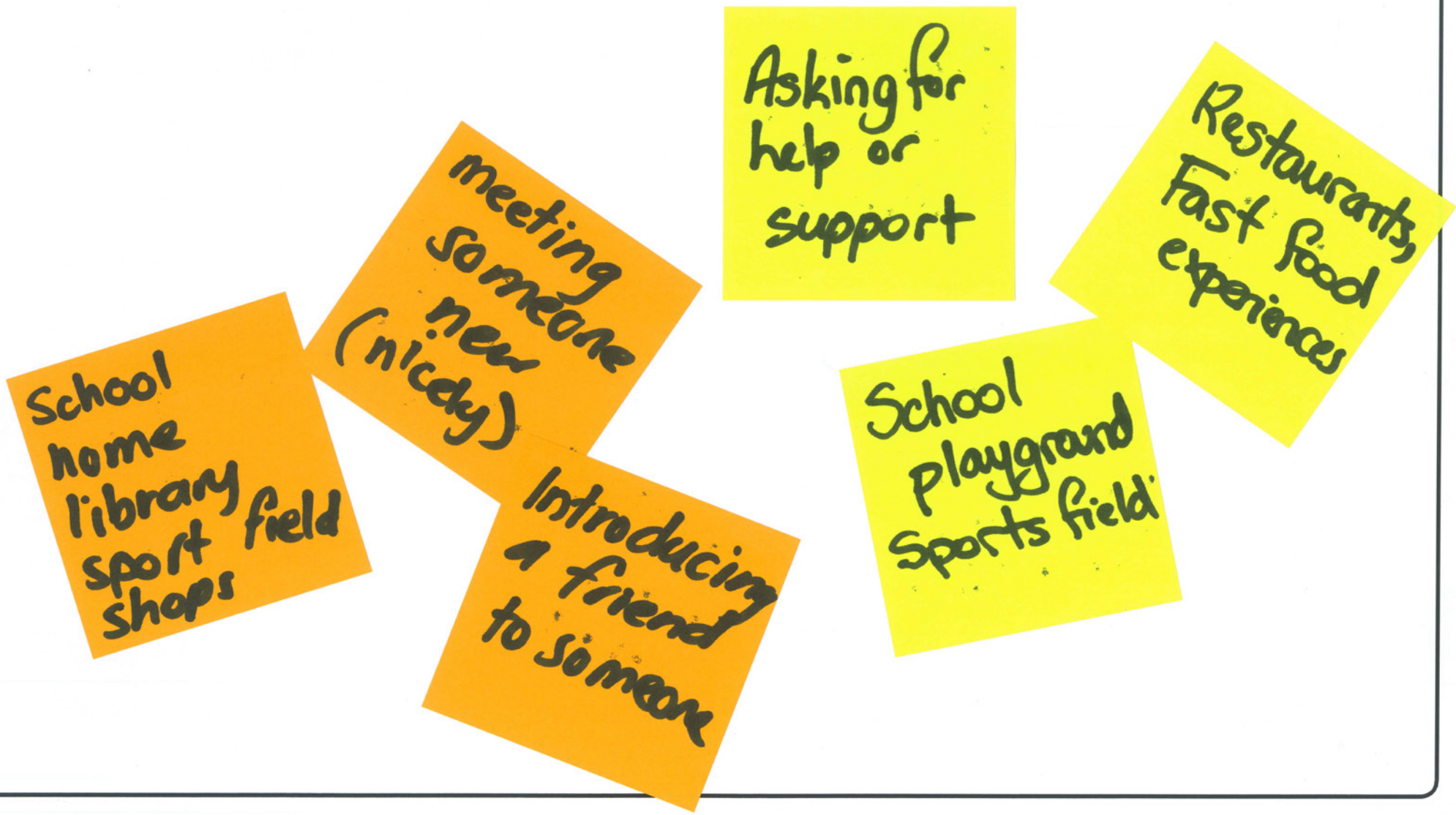
Media requirements for the game/app? What would it need to have & why?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...

Question:

Scenarios - what scenes, situations or places would be helpful to include in the game?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...



Question:

What would success for your DHH students look like?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...

Question:

What resources exist already? What would you change or keep the same?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...

Question:

In an ideal world, what could the game/tool be or do?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...

Question:

What elements of d/Deaf culture would you like to see included in digital tools?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...

Question:

What hobbies do your students enjoy? How could these be used for additional learning?

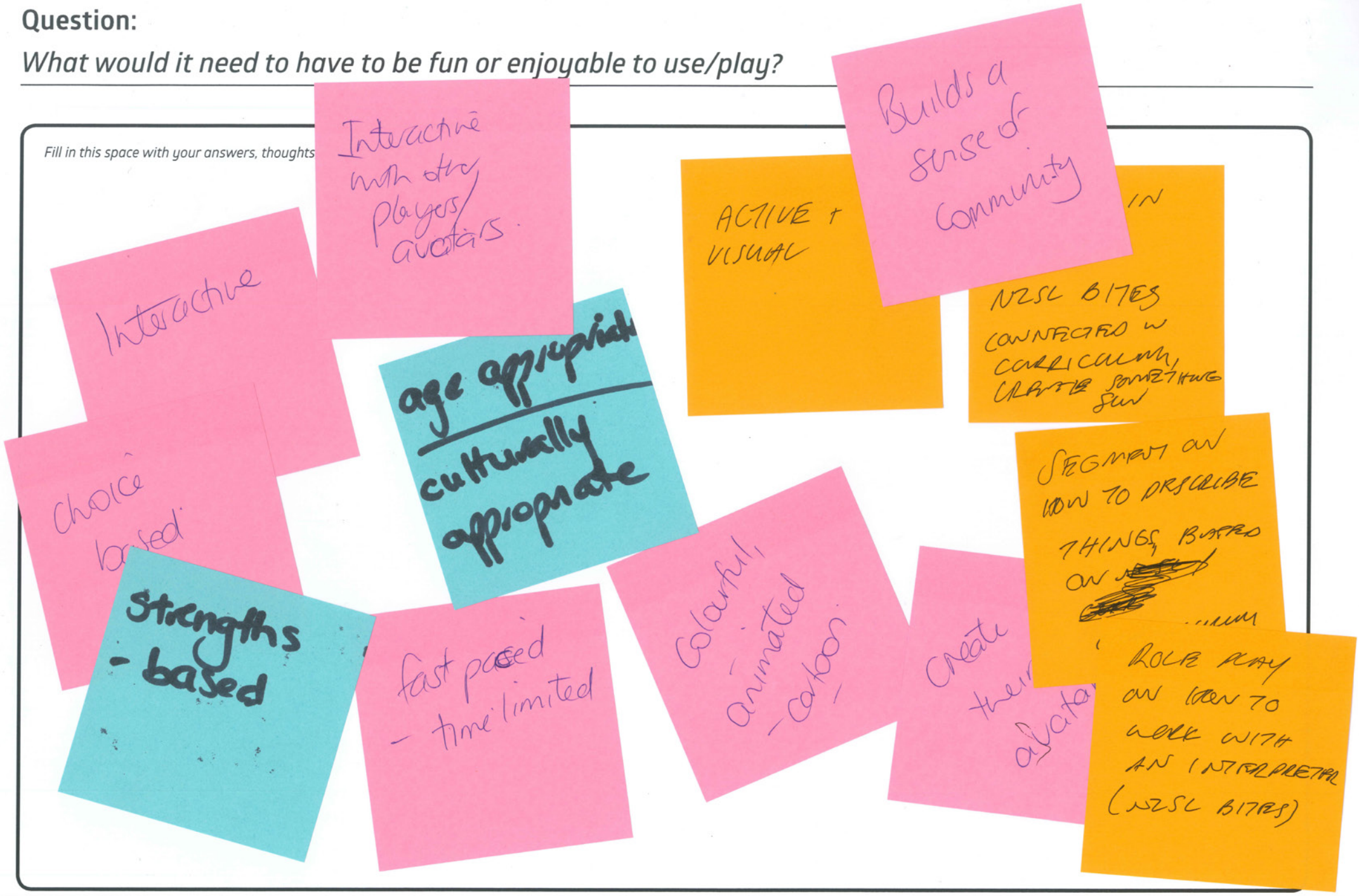
Fill in this space with your answers, thoughts, ideas or experiences, drawings...


Seeing it unfold - seeing as much as possible, able to review repeat
Take 1
Perfect Scenario
Take 2
Run the scenario with choices - gamer decides which path to take to get to the desired end result.
based - grapevine
sign lang
VIDEO CLIP CREATIVE SKILLS TO THINK ABOUT BEFORE & AFTER, WHAT ARE THEY THINKING?
what would the end look like
students
what happened by this student?
Visual representation of scenarios
Made in 3 languages NZSL spoken Māori
multi-bi cultural contexts + figures
odelling
OBJECTS, SHOWING THE REAL WORLD
LANGUAGE,
choice
language (little amount)
contextual & authentic
TAKE THINGS, SLOW, WHAT WOULD YOU DO IN THIS SCENARIO? STOP VIDEO.
level

Question:

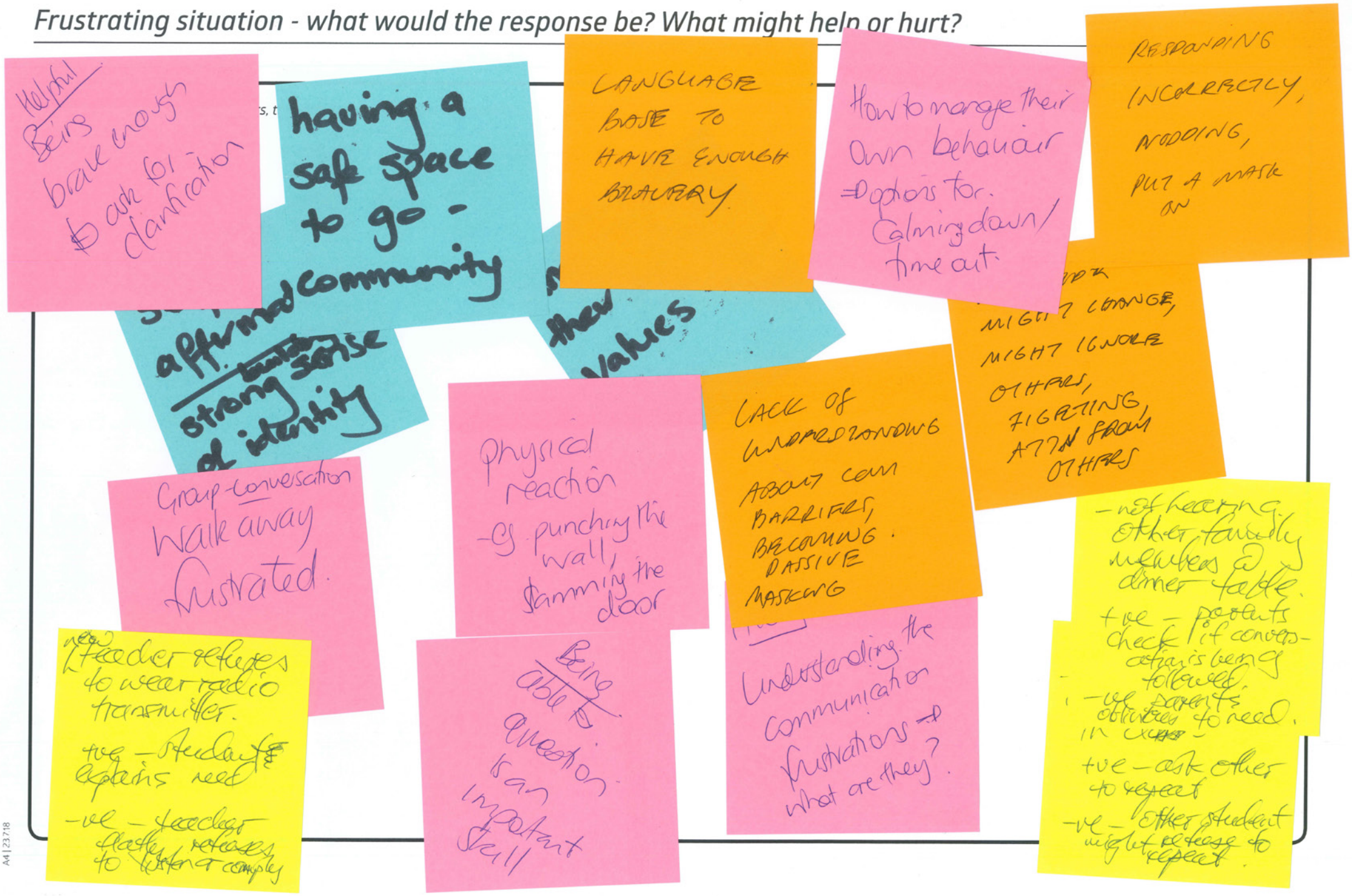
What would it need to have to be fun or enjoyable to use/play?

Fill in this space with your answers, thoughts



Question:

Frustrating situation - what would the response be? What might help or hurt?



Question:

Media requirements for the game/app? What would it need to have & why?

Fill in this space with your answers, thoughts, ideas or experiences, dr... s...

Question:

Scenarios - what scenes, situations or places would be helpful to include in the game?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...

Question:

What would success for your DHH students look like?

Fill in this spa... oeriences, drawings...

Strong sense of identity

Communicating their pepeha

IEPs : what it is to be successful

being encouraged, being positive, finding own path

- satisfactory conversations
- feeling good
- conversation partner feeling good

Being able to generalize the skills learned in the same, in real life situations

Self - advocacy & knowing their rights

Being confident independent contributors to society

Knowing their values

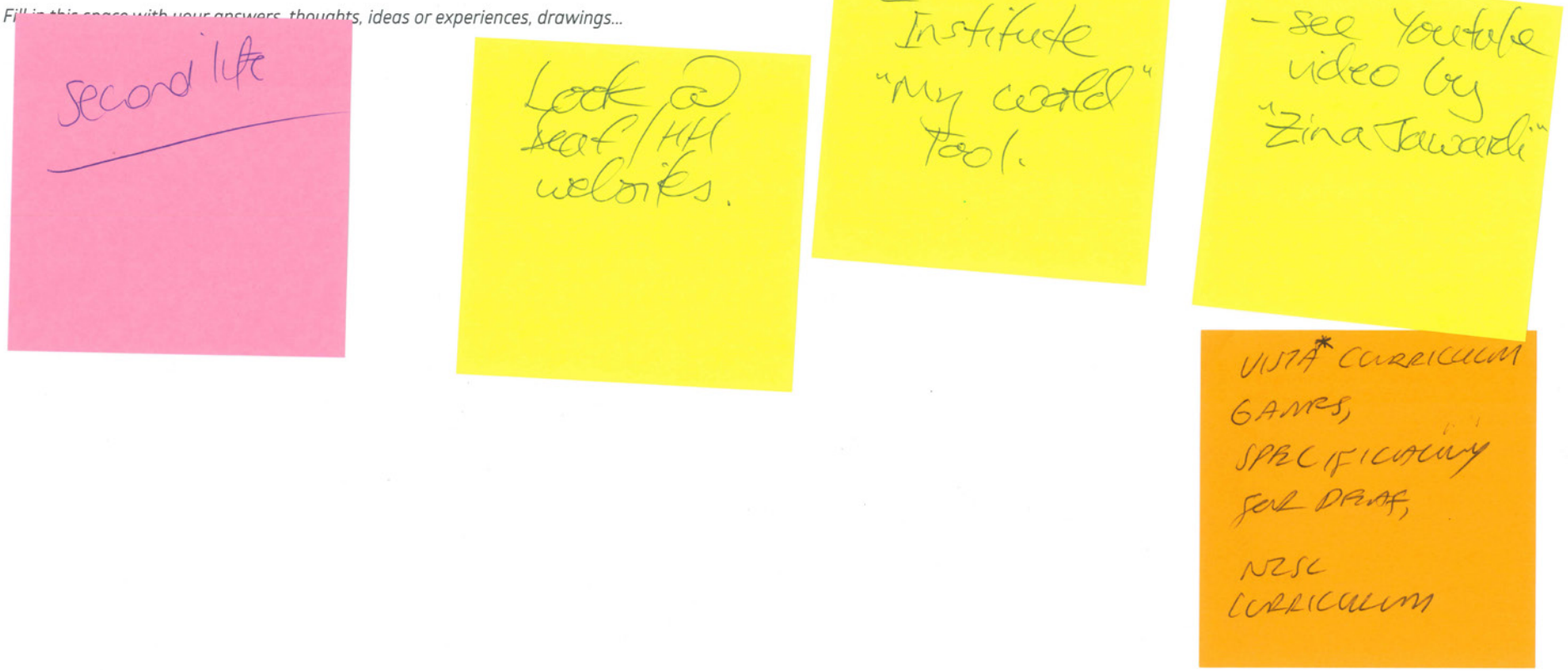
self belief

Courageous to support one's self.

Question:

What resources exist already? What would you change or keep the same?

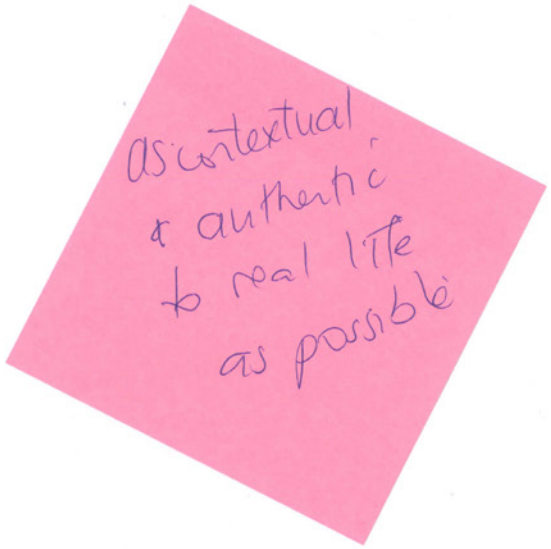
Fill in this space with your answers, thoughts, ideas or experiences, drawings...

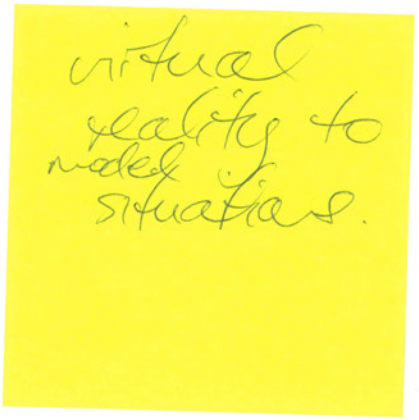


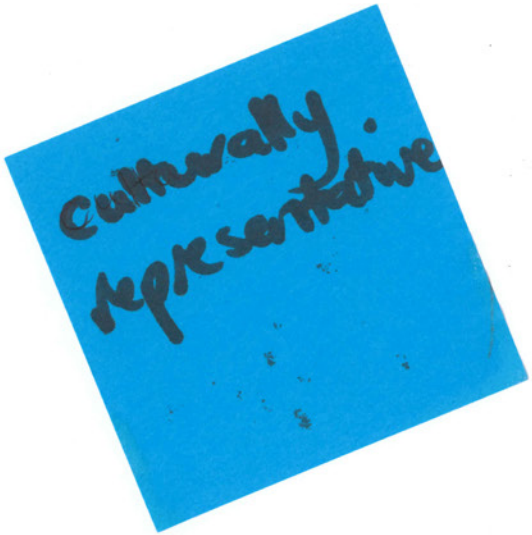
Question:

In an ideal world, what could the game/tool be or do?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...



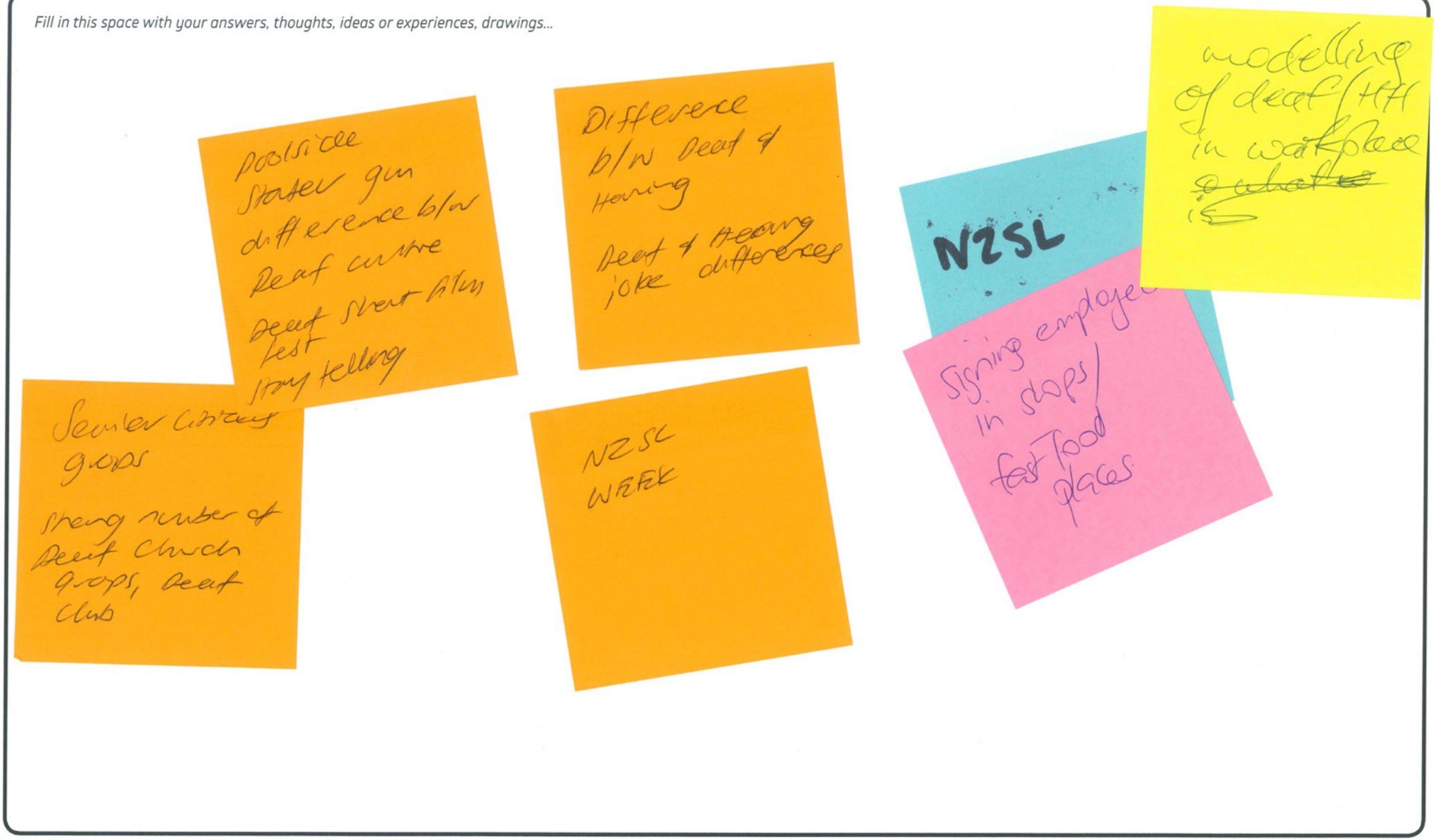




Question:

What elements of d/Deaf culture would you like to see included in digital tools?

Fill in this space with your answers, thoughts, ideas or experiences, drawings...



Appendix B: ICDVRAT Conference Paper (Platt-Young et al., 2018)

Designing for the Deaf: The potential of technology supported social skills training interventions for d/Deaf and Hard of Hearing students

Platt-Young, Zoe[1], Shahri, Bahareh[2], Hector, Zoe[3], Sutherland, Dean[3], Hoermann, Simon[1,2]

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ABSTRACT

Technology-supported social communication and pragmatics training for d/Deaf and Hard of Hearing (DHH) students is an important avenue of research. In this paper we describe some key challenges that DHH students face, the human centered design process used to uncover insights with stakeholders, and the potential of technology-based interventions to support development of social pragmatic skills. We further describe user experience considerations for DHH students, identified through discussions with subject matter experts, from a review of the literature, and identified through ongoing interviews with educators and parents, in addition to focus groups with teachers of the deaf.

1. INTRODUCTION

Deaf and Hard of Hearing (DHH) students face several challenges in the acquisition and development of effective communication and social skills. Over the past 30 years, the development of hearing device technology such as cochlear implants and early detection of deafness have contributed to significant progress in enabling DHH students to access sound. However accessing spoken communication is one step in developing effective interpersonal communication. Further steps include understanding the nuances of conversations and social interactions, which require considerable learning about self and others, and is a well-documented challenge for DHH students (Peterson & Siegal, 2000). The design, development and use of technology-based interventions to support social skill development in DHH students in an area of practice that has received limited research attention.

Increasingly sophisticated hearing technology has contributed to a majority of DHH students learning oral language and attending mainstream education settings. A key to success in these settings is having effective social-pragmatic skills (Luckner & Muir, 2001). Delays in language development are relatively common for DHH students compared to their hearing peers, particularly when the deaf or hard of hearing student is born to hearing parents. These delays in language acquisition have a substantial impact on theory of mind development and executive functioning; areas associated with the ability to attribute mental states to others, consider multiple perspectives and communicate with others effectively (Peterson & Siegal, 2000). These are also areas that students on the Autism spectrum experience significant challenges with.

Practical teaching of social pragmatic and communication skills is often needed, and strategies such as role-play are occasionally utilised by subject matter experts (SMEs) such as resource teachers of the deaf (Marschark & Spencer, 2003). However, due to finite time and resources available to each deaf student, technological support that students can access in a flexible way could provide valuable learning opportunities and reinforcement mechanisms. Such interventions could create a safe place for students in which to learn effective communication strategies, building their resilience in a way that also prepares them for meaningful engagement and more active involvement in social interactions within and outside the classroom. The potential of serious games to offer

valuable learning opportunities in an intrinsically motivating way is discussed in detail by several authors (e.g. McGonigal, 2011; Walz et al., 2015) who conceptualise them as engaging mediums that can employ highly motivating strategies and mechanics such as choice, autonomy, rewards and feedback for effort and persistence, flexible identities and clear goals.

In this paper, we first present our findings from a literature search and formative consultations with subject matter experts. We then describe areas of social communication identified as important for consideration in the intervention, and discuss preliminary findings arising from primary data collected in interviews, and the implications for user experience design of the intervention. Finally, we suggest future evaluation through an iterative human-centered design process with resource teachers, teachers of the deaf and DHH students.

2. BACKGROUND

We conducted a structured literature search to provide an overview of the current state of the art in technology-supported social skill interventions for DHH children and young people. Due to a lack of results, we extended the search strategy to include interventions for students on the autism spectrum where the nature of the intervention was identified as being potentially relevant to DHH students. For example interventions dealing with Theory of Mind, executive function and effective social communication. Including this secondary user group of ASD students was theorised to be relevant due to studies, which have demonstrated that DHH students can have delays in these areas akin to autistic children (Peterson & Siegal, 2000).

The final search strategy was then specific to include in the search a game or AR/VR application(s) that had the primary goal of providing a social skills intervention for deaf or hard of hearing students under 21 years of age or people with an autism spectrum disorder. The search was carried out on the following databases: COMPENDEX (which indexes IEEE and ACM), EMBASE, MEDLINE, ICDVRAT archive, PsycINFO, Scopus and Web of Science. A detailed outline of the search strategy including the specified inclusion and exclusion criteria is available in Prospero using CRD42018092708 as the ID (Platt-Young & Hoermann, 2018).

Searching the seven databases and initial screening to remove duplicates and irrelevant papers resulted in 92 possible papers that met the inclusion and exclusion criteria specified in the search strategy (ibid.). The majority of the studies were found to have an ASD focus; very few are primarily focused on interventions for deaf or hard of hearing students. This suggests a paucity in the research into how technology-based interventions can best be designed for DHH students.

Necessitated by the relatively sparse information provided in the literature regarding guidelines for the design of technological social-skill and pragmatics interventions for DHH students, we consulted with subject matter experts including teachers of the deaf in mainstream school settings. SME feedback has identified several areas for exploration, which will be further researched in interviews and focus groups with resource teachers of the deaf, speech language therapists and parents. These areas are: conversational repair strategies, contextual barriers, self-advocacy, self-efficacy, and stigma. In addition peripheral areas such as: theory of mind, executive function, scaffolding and role-modelling, were also identified.

Stigma was identified as a reason for why low functioning students may be struggling in social pragmatic areas, due to a perceived lack of family acceptance of their hearing status and hearing accommodation usage. Family acceptance of the hearing status of a deaf child appears to be of critical importance in counteracting stigma. This is also reflected in the previous work of researchers who have investigated factors for DHH student success and resilience (Ahlert & Greeff, 2012; Luckner & Muir, 2001), and has been further confirmed in recent interviews and focus groups. An insidious form of stigma can also be low expectations of the DHH student to succeed in education settings.

Contextual barriers describe environmental factors impacting DHH students' ability to communicate effectively and participate in social interaction. Examples identified by resource teachers are visual stimulus and noisy outdoor environments which present significant challenges and can lead to frustrations. Pre-teaching clear communication strategies for dealing with interactions that occur outside the classroom was identified as important by teachers of the deaf, and one Resource Teacher of the Deaf (RTD) described a strategy where they would record the DHH student playing outside and discuss with the student behaviours that had occurred, in an effort to provide feedback relevant to the communication context and associated barriers.

Conversational repair strategies describe strategies that students take to correct a misunderstanding, provide someone with clarification, or to request clarification, for example by asking another to repeat or rephrase a question. One RTD referred to question skill training being of high importance in his work with DHH students. A lack of questioning and repair skills can significantly impact interactions with peers and DHH students are often specifically delayed in these areas (Yoshinaga-Itano, 2015).

Self Advocacy describes acting and speaking on one's behalf, and in discussions with educators regarding possible goals DHH students may have, a lack of goals or demonstrating self advocacy skills was attributed to language deficiencies. Self advocacy appears significantly linked to students' language and communicative skills, which has been demonstrated in research investigating self advocacy differences between hard of hearing (HH) students and hearing peers (Michael & Zidan, 2018).

Self-Efficacy is one's belief in oneself to accomplish a task and to take actions towards goals (Bandura, 1982). In primary data collected to date, educators have drawn attention to expectations of DHH students being too high or too low as being a possible factor for how attainable goals are for students, describing incremental learning as an optimal strategy for students. This would presumably be well accomplished through a game-based learning model that breaks larger goals down into manageable

Cawthon et al. describe in their review of research into the social skill development of deaf youth two main theoretical frameworks when considering social skills research: *socioemotional perspectives* that focus on behaviours and interactions, and *humanistic ones* that focus on personal qualities such as self-concept (Cawthon, Fink, Schoffstall, & Wendel, 2018). It is probable that near equal focus on both is needed in the intervention, as opportunities to practice communication skills and behaviours could reinforce a student's self-concept and belief in future success in social interactions. Both frameworks are important when considering a game-based learning approach, as game mechanics focus on behaviours and games additionally offer the opportunity to role-play and take on alternate identities.

The acceptance and feasibility of interactive video games in addressing pragmatics areas has confirmed by teachers and parents to be worthwhile. Respondents have their DHH students/children find games to be highly engaging, especially if they include rewarding feedback to provide the motivation needed to persevere if success was not forthcoming. Such mechanics could support self-efficacy development by providing an achievable goal. Captions and language modality considerations are also a recommendation for further research and implementation efforts.

3. FRAMEWORK

Human-centered and goal-directed design processes (Cooper, 2014) are employed in this project in addition to a Grounded Theory framework to define themes for the development of personas. Interviews are in progress with teachers of the deaf, resource teachers of the deaf, mainstream teachers and parents of DHH students. For reasons of privacy and anonymity, interviews with parents were deemed a more adequate method when compared with other methods. The plan is for interviews to continue until saturation can be achieved (Corbin & Strauss, 2008).

A variety of hearing accommodations and needs, different language and cultural backgrounds, varying reading ages, and different affinities with technology and abilities means that developing a first version of the game needs to be well thought out. For this reason, a continual and incremental development process is used in partnership with teachers of the deaf, some of whom are DHH themselves, offering valued input at various stages of the process.

Interviews and Focus Groups: Semi-structured interviews were identified as a primary method (Silverman, 2009) to gather SME input regarding social skills, social communication, user experience and technology considerations. These interviews focus on topics identified in SME consultations and include device use, gameplay and interface preferences, scenarios and general user experience considerations. Emergent themes are identified by coding interview transcripts, which further defines questions for future enquiry until saturation is achieved (Corbin & Strauss, 2008). The strategy implemented in the focus groups is the pursuit of a combination of reflective and ideation questions with teachers to elicit accurate personas and develop scenarios that are appropriate for student learning. Focus groups with resource teachers of the deaf, teachers of the deaf, mainstream teachers and speech language therapists are ongoing, and two focus groups, one with two teachers of the deaf in a satellite class within a mainstream school (both hearing), and one involving three RTDs (one hearing and two deaf) have been conducted. Initial findings highlight the importance of role play, explicit teaching of repair strategies, d/Deaf role models, interactivity and language skill development for pragmatic interventions.

Personas and Scenarios: Personas are employed to translate abstract information into a tangible research tool for the design effort and are particularly useful in an area such as this, where there may not be an established paradigm and in an effort to limit design assumptions and bias (Cooper, 2014; Pruitt & Grudin, 2003). Scenarios are two-fold in the project, describing interaction scenarios between end users of the game and the interface, and scenes that users can role-play that are illustrative of communication situations that provide valuable learning experiences. An example of a possible scenario is that of sports activity, as this was identified in interviews with parents and teachers as a common example of where communication breakdowns regularly occur. Personas and

scenarios will be validated with resource teachers, as these individuals are highly knowledgeable about the target users and several are DHH themselves so they have a unique perspective that will assist in with the refinement.

User Experience Workshop: Low-fidelity concepts will be evaluated with DHH students between ages 6-12 in a user experience workshop, as this is the hypothesised age group most likely to benefit from the intervention given the expectation for students to be independent learners during secondary school. The idea is to view DHH students as co-design partners by their inclusion as testers (Guha, Druin, & Fails, 2008) using the user experience workshop as an opportunity to collect their recommendations and perspectives.

4. CONCLUSIONS

In this paper we have provided background information regarding pertinent areas of effective social communication and outlined the potential of technology-supported pragmatics training for DHH students. Through consultations with subject matter experts including teachers and parents we have identified key domains where technology could play a role in fostering social skills development. Focus groups and continued interviews with teachers of the deaf are suggested as a next step to prepare personas and scenarios in order to establish a design framework that further informs the development of effective technological interventions.

5. REFERENCES

Ahlert, I. A., & Greeff, A. P. (2012). Resilience Factors Associated With Adaptation in Families With Deaf and Hard of Hearing Children. *American Annals of the Deaf, 157*(4), 391-404.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122-147. doi:10.1037/0003-066X.37.2.122

Cawthon, S. W., Fink, B., Schoffstall, S., & Wendel, E. (2018). In the Rearview Mirror: Social Skill Development in Deaf Youth, 1990–2015. *American Annals of the Deaf, 162*(5), 479-485. doi:10.1353/aad.2018.0005

Cooper, A. (2014). *About face: the essentials of interaction design* (Fourth ed.). Indianapolis, Indiana: Wiley.

Corbin, J. M., & Strauss, A. L. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory. 3. ed*. Los Angeles, Calif. u.a: Sage Publ.

Guha, M., Druin, A., & Fails, J. (2008, 2008). *Designing with and for children with special needs: an inclusionary model*.

Luckner, J. L., & Muir, S. (2001). Successful Students Who Are Deaf in General Education Settings. *American Annals of the Deaf, 146*(5), 435-446. doi:10.1353/aad.2012.0202

McGonigal, J. (2011). *Reality is broken: why games make us better and how they can change the world*. New York: Penguin Press.

Michael, R., & Zidan, H. M. (2018). Differences in self-advocacy among hard of hearing and typical hearing students. Research in Developmental Disabilities, 72, 118–127. https://doi.org/10.1016/j.ridd.2017.11.005

Peterson, C. C., & Siegal, M. (2000). Insights into Theory of Mind from Deafness and Autism. Mind & Language, 15(1), 123-145. doi:10.1111/1468-0017.00126

Pruitt, J., & Grudin, J. (2003, 2003). *Personas: practice and theory*.

Silverman, D. (2009). *Doing qualitative research: a practical handbook* (3rd ed.). London: SAGE.

Walz, S. P., Lantz, F., Deterding, S., Andrews, L., Benson, B., Bogost, I., . . . Lampe, C. (2015). *Gameful World : Approaches, Issues, Applications*. Cambridge, UNITED STATES: MIT Press.

Yoshinaga-Itano, C. (2015). The missing link in language learning of children who are deaf or hard of hearing: pragmatics. *Cochlear implants international, 16 Suppl 1*(sup1), S53-S54. doi:10.1179/1467010014Z.000000000237

Appendix C: Educational Research Human Ethics Approval Letter for Amendment

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: 2017/54/ERHEC Amendment 1

2 May 2018

Zoe Platt-Young
HIT Lab NZ
UNIVERSITY OF CANTERBURY

Dear Zoe

Thank you for your request for an amendment to your research proposal "Using Human Centred Design and Qualitative Research Practices to Design a Computer Game for Social Skills Training of Deaf and Hard-of-Hearing Youth" as outlined in your email dated 30th April 2018. I am pleased to advise that this amendment has been considered and approved by the Educational Research Human Ethics Committee.

Please note that should circumstances relevant to this current application change you are required to reapply for ethical approval.

If you have any questions regarding this approval, please advise.

We wish you well for your continuing research.

Yours sincerely

pp R. Robinson

Dr Patrick Shepherd
Chair
Educational Research Human Ethics Committee

Please note that ethical approval relates only to the ethical elements of the relationship between the researcher, research participants and other stakeholders. The granting of approval by the Educational Research Human Ethics Committee should not be interpreted as comment on the methodology, legality, value or any other matters relating to this research.

F E S

Appendix D: Educational Research Human Ethics Approval Letter

HUMAN ETHICS COMMITTEE

Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: 2017/54/ERHEC

20 March 2018

Zoe Platt-Young
HIT Lab NZ
UNIVERSITY OF CANTERBURY

Dear Zoe

Thank you for providing the revised documents in support of your application to the Educational Research Human Ethics Committee. I am very pleased to inform you that your research proposal **"**Using Human Centred Design and Qualitative Research Practices to Design a Computer Game for Social Skills Training of Deaf and Hard-of-Hearing Youth" has been granted ethical approval.

Please note that this approval is subject to the incorporation of the amendments you have provided in your emails of 20th December 2017, 10th and 23rd February and 19th March 2018.

Should circumstances relevant to this current application change you are required to reapply for ethical approval.

If you have any questions regarding this approval, please let me know.

We wish you well for your research.

Yours sincerely

pp R. Robinson

Dr Patrick Shepherd
Chair
Educational Research Human Ethics Committee

Please note that ethical approval relates only to the ethical elements of the relationship between the researcher, research participants and other stakeholders. The granting of approval by the Educational Research Human Ethics Committee should not be interpreted as comment on the methodology, legality, value or any other matters relating to this research.

F E S

Appendix E: Educational Research Human Ethics Recruitment Poster

HITLabNZ
Human Interface Technology Lab New Zealand
Hangarau Tangata, Tangata Hangarau

UC
UNIVERSITY OF CANTERBURY

Talk Town

CALL FOR PARTICIPANTS!

Are you a teacher or parent of a d/Deaf or Hard of Hearing student? Be part of a project to design a game for DHH students!

We are designing a game for deaf and hard of hearing students and need your help. **As parents and teachers of DHH students, you have a unique perspective to offer.**

Our game plans to teach some social skills and to provide students with strategies for effective communication - as this is something closely linked to academic success, employment and life fulfilment of DHH individuals.

To help design the game, we invite you to participate in remote interviews, where a range of topics will be discussed. During these sessions, I will raise topics such as the following:

- Emotion regulation and management
- Conversation skills
- Peer relationships
- Problem solving and resilience
- Hobbies, extra-curriculars, interests and games your students and children enjoy.

If you want to participate, please email me and I will be in touch with more information.
Email: **zoe.platt-young@pg.canterbury.ac.nz**

How?
Email **zoe.platt-young@pg.canterbury.ac.nz** to find out more!

Time?
30-60 minutes.

Where?
Over Skype, from the comfort of your own home.

Vouchers
Participants receive a small voucher for their time.

Approved by the University of Canterbury Educational Research Human Ethics Committee.

Let's talk about a game for d/Deaf students!
zoe.platt-young@pg.canterbury.ac.nz

Appendix F: Educational Research Human Ethics Information Sheet and Consent Forms for Remote Interviews: Parents

Department: Human Interface Technology Laboratory
Telephone: +64 27 481 5592
Email: zoe.platt-young@canterbury.ac.nz
26.07.2018

Using Human Centered Design and Qualitative Analysis to Design a Game Prototype for Social Skills Augmentation of Deaf and Hard-of-Hearing Students

Information Sheet for Parents and Caregivers (Remote, Phone or Video Chat Interviews)

Dear Parents and Caregivers,

We are developing a game to support deaf student's social skills, and would like to invite you to take part in our research. We are creating this game in the hope that improved social skills will lead to better social, academic and employment outcomes for students.

This study is being conducted by myself, Zoe Platt-Young, a Master of Human Interface Technology student, under the supervision of Dr. Simon Hoermann and Dr. Dean Sutherland. You have been identified as a possible participant because you are a parent or caregiver of a d/Deaf or hard of hearing child. Your expert knowledge will be very helpful to include in the game design.

Purpose of the Remote Interview: To discuss areas of social skills and communication related to deaf and hard of hearing students, social communication strategies, behaviour, accommodations and associated needs and experiences. These insights will then be used to design a game prototype (in-progress version of the game).

The format will be a loosely-structured interview format where I will introduce topics for discussion and you will be invited to answer. Some areas that may be discussed are:

- Tools for building social skills of students
- Possible differences in communication and social interaction needs of deaf and hard of hearing students
- Technology use and media requirements of deaf and hard of hearing students
- Hobbies, games and sports preferences or habits
- Behaviour management
- Emotional self-regulation of students
- Stigma related to being deaf or hard of hearing
- Relationships with peers, friendship formation, bullying, positive social encounters

Some participatory design exercises such as persona and scenario activities will take place as the research progresses. These activities are to improve the game so it properly meets the needs of deaf and hard of hearing students and so the game can be as accurate and engaging as possible.

An example of this would be to discuss a possible 'example student' who is deaf and what their usage of technology might be like, for instance their device use and challenges answering questions on a screen and what their interests might be.

Another design activity may be to look at an in-progress version of the game and to discuss how it might be used by deaf and hard of hearing students and what might make it more user-friendly or interesting to students.

Interviewees and Researchers Present: Only you and the principal researcher (myself, Zoe Platt-Young) will be present.

Date: July or August 2018

Location: Either via phone call or a Video Chat medium such as Skype or Facetime.

Duration: Between 30 – 60 minutes

Withdrawing*: **participation is voluntary and you can decide not to participate. However, once the remote interview starts it will not be possible to remove your data. You are however able to leave the session at any time should you feel uncomfortable and not wish to continue.***

Data Collection*:* Conversational data from the interview will be transcribed and pseudonymised to protect your confidentiality before it is shared (in any transcripts you will be referred to via a pseudonym rather than by your real name). I will email you a summary of the interview discussion if you indicate you wish to receive this by supplying an email address on the consent form.

Audio, Video and Photographic Recording in Interviews: Audio recordings, video and photographs will be taken during the interviews to aid the research. No media featuring your recognisable image or voice will be shared with anyone beyond the researchers. If photographs are used in publications they will be blurred and/or a filter applied to obscure any parts of the image that would show your identity/that you participated in the session.

Data Storage: Data will be safely kept for no less than five years and then deleted. However, if required some pseudonymized data might be shared with other researchers if there is a reasonable scientific or educational need to do so.

Publication of Research: The results of this research will be published in my MHIT thesis, which will be available through the library of the University of Canterbury. Publication of the results in Human-Computer Interaction, social sciences, technology, scientific and/or medical outlets is envisioned as well as for communication and marketing purposes.

Major dissemination of this research will be announced on the Facebook page (www.facebook.com/HITLabNZ) as well as the webpage (hwww.hitlabnz.org/index.php/publications) of the HIT Lab NZ where a link to the publication will be provided.

I am carrying out this research in partial fulfilment of the Master of Human Interface Technology thesis by myself, Zoe Platt-Young under the supervision of Dr. Simon Hoermann (simon.hoermann@canterbury.ac.nz) and Dr. Dean Sutherland (dean.sutherland@canterbury.ac.nz), who will be pleased to discuss any concerns you may have about participation in the project.

Having read the information provided, you can decide whether you want to participate in this research project. This letter is yours to keep. As a next step you will be asked to complete the consent form that is to be returned to the researcher, Zoe Platt-Young.

This project has been reviewed and approved by the University of Canterbury Educational Research Human Ethics Committee, and participants should address any complaints to The Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

Zoe Platt-Young

Department: Human Interface Technology Laboratory
Telephone: +64 27 481 5592
Email: zoe.platt-young@canterbury.ac.nz
26.07.2018

Using Human Centered Design and Qualitative Analysis to Design a Game Prototype for Social Skills Augmentation of Deaf and Hard-of-Hearing Students

Consent Form for Parents and Caregivers (Remote, Phone or Video Chat Interviews)

☐I have been given a full explanation of this project and have had the opportunity to ask questions.

☐I understand what is required of me if I agree to take part in the research.

☐I understand that participation is voluntary.

☐I understand that any information or opinions I provide will be kept confidential to the researcher and that any published or reported results will not identify the participants. I understand that a thesis is a public document and will be available through the library of the University of Canterbury.

☐I understand that all data collected for the study will be kept in locked and secure facilities and will be destroyed after five years.

☐I understand that any video, photographic and audio media featuring my likeness will not be shared with anyone beyond the researchers.

☐I understand that pseudonymised data might be shared with other researchers if there is a reasonable scientific or pedagogic need to do so.

☐I understand that I can access the Facebook page or the webpage of the HIT Lab NZ to find information about disseminations and summaries of the outcomes of this research once they become available.

☐I understand that I can contact the researcher, Zoe Platt-Young, or supervisor Dr. Simon Hoermann (simon.hoermann@canterbury.ac.nz) and Dr. Dean Sutherland (dean.sutherland@canterbury.ac.nz,) for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Educational Research Human Ethics Committee, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

☐By signing below, I agree to participate in this research project.

*Name:*_____*Signed:*_____*Date:*

Email address *(for report of findings, if applicable)*:

Please return this Consent Form to the researcher via hard copy in-person or e-mail (zoe.platt-young@canterbury.ac.nz)

Zoe Platt-Young

Appendix G: Educational Research Human Ethics Information Sheet and Consent Forms for Remote Interviews: Teachers

Department: Human Interface Technology Laboratory
Telephone: +64 27 481 5592
Email: zoe.platt-young@canterbury.ac.nz
29.06.2018

Using Human Centered Design and Qualitative Analysis to Design a Game Prototype for Social Skills Augmentation of Deaf and Hard-of-Hearing Students

Information Sheet for Teachers (Remote, Phone or Video Chat Interviews)

Dear Teachers,

We are developing a game to support deaf student's social skills, and would like to invite you to take part in our research. We are creating this game in the hope that improved social skills will lead to better social, academic and employment outcomes for these students.

This study is being conducted by myself, Zoe Platt-Young, a Master of Human Interface Technology student, under the supervision of Dr. Simon Hoermann and Dr. Dean Sutherland. You have been identified as a possible participant because you're either a primary or secondary school teacher, or a Teacher of the Deaf. Your expert knowledge will be very helpful to include in the game design.

Purpose of the Remote Interview: To discuss areas of social skills and communication related to deaf and hard of hearing students, social communication strategies, behaviour, accommodations and associated needs and experiences. These insights will then be used to design a game prototype (in-progress version of the game).

The format will be a loosely-structured interview format where I will introduce topics for discussion and you will be invited to answer. Some areas that may be discussed are:

- Tools for building social skills of students
- Possible differences in communication and social interaction needs of deaf and hard of hearing students
- Successful students and what you believe contributes to their success
- Technology use and media requirements of deaf and hard of hearing students
- Hobbies, games and sports preferences or habits
- Behaviour management
- Emotional self-regulation of students
- Stigma related to being deaf or hard of hearing
- Relationships with peers, friendship formation, bullying, positive social encounters

Some participatory design exercises such as persona and scenario activities will take place as the research progresses. These activities are to improve the game so it properly meets the needs of deaf and hard of hearing students and so the game can be as accurate and engaging as possible.

An example of this would be to discuss a possible 'example student' who is deaf and what their usage of technology might be like, for instance their device use and challenges answering questions on a screen and what their interests might be.

Another design activity may be to look at an in-progress version of the game and to discuss how it might be used by deaf and hard of hearing students and what might make it more user-friendly or interesting to students.

Interviewees and Researchers Present: Only you and the principal researcher (myself, Zoe Platt-Young) will be present.

Date: July 2018

Location: Either via phone call or a Video Chat medium such as Skype or Facetime.

Duration: Between 30 – 60 minutes

Withdrawing*: **participation is voluntary and you can decide not to participate. However, once the remote interview starts it will not be possible to remove your data. You are however able to leave the session at any time should you feel uncomfortable and not wish to continue.***

Data Collection*:* Conversational data from the interview will be transcribed and pseudonymised to protect your confidentiality before it is shared (in any transcripts you will be referred to via a pseudonym rather than by your real name). I will email you a summary of the interview discussion if you indicate you wish to receive this by supplying an email address on the consent form.

Audio, Video and Photographic Recording in Interviews: Audio recordings, video and photographs will be taken during the interviews to aid the research. No media featuring your recognisable image or voice will be shared with anyone beyond the researchers. If photographs are used in publications they will be blurred and/or a filter applied to obscure any parts of the image that would show your identity/that you participated in the session.

Data Storage: Data will be safely kept for no less than five years and then deleted. However, if required some pseudonymized data might be shared with other researchers if there is a reasonable scientific or educational need to do so.

Publication of Research: The results of this research will be published in my MHIT thesis, which will be available through the library of the University of Canterbury. Publication of the results in Human-Computer Interaction, social sciences, technology, scientific and/or medical outlets is envisioned as well as for communication and marketing purposes.

Major dissemination of this research will be announced on the Facebook page (www.facebook.com/HITLabNZ) as well as the webpage (hwww.hitlabnz.org/index.php/publications) of the HIT Lab NZ where a link to the publication will be provided.

I am carrying out this research in partial fulfilment of the Master of Human Interface Technology thesis by myself, Zoe Platt-Young under the supervision of Dr. Simon Hoermann (simon.hoermann@canterbury.ac.nz) and Dr. Dean Sutherland (dean.sutherland@canterbury.ac.nz), who will be pleased to discuss any concerns you may have about participation in the project.

Having read the information provided, you can decide whether you want to participate in this research project. This letter is yours to keep. As a next step you will be asked to complete the consent form that is to be returned to the researcher, Zoe Platt-Young.

This project has been reviewed and approved by the University of Canterbury Educational Research Human Ethics Committee, and participants should address any complaints to The Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

Zoe Platt-Young

Department: Human Interface Technology Laboratory
Telephone: +64 27 481 5592
Email: zoe.platt-young@canterbury.ac.nz
29.06.2018

Using Human Centered Design and Qualitative Analysis to Design a Game Prototype for Social Skills Augmentation of Deaf and Hard-of-Hearing Students

Consent Form for Teachers (Remote, Phone or Video Chat Interviews)

- ☐ I have been given a full explanation of this project and have had the opportunity to ask questions.
- ☐ I understand what is required of me if I agree to take part in the research.
- ☐ I understand that participation is voluntary.
- ☐ I understand that any information or opinions I provide will be kept confidential to the researcher and that any published or reported results will not identify the participants. I understand that a thesis is a public document and will be available through the library of the University of Canterbury.
- ☐ I understand that all data collected for the study will be kept in locked and secure facilities and will be destroyed after five years.
- ☐ I understand that any video, photographic and audio media featuring my likeness will not be shared with anyone beyond the researchers.
- ☐ I understand that pseudonymised data might be shared with other researchers if there is a reasonable scientific or pedagogic need to do so.
- ☐ I understand that I can access the Facebook page or the webpage of the HIT Lab NZ to find information about disseminations and summaries of the outcomes of this research once they become available.
- ☐ I understand that I can contact the researcher, Zoe Platt-Young, or supervisor Dr. Simon Hoermann (simon.hoermann@canterbury.ac.nz) and Dr. Dean Sutherland (dean.sutherland@canterbury.ac.nz,) for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Educational Research Human Ethics Committee, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).
- ☐ By signing below, I agree to participate in this research project.

*Name:*_____ *Signed:*_____ *Date:*

Email address *(for report of findings, if applicable)*:

_____

Please return this Consent Form to the researcher via hard copy in-person or e-mail (zoe.platt-young@canterbury.ac.nz)

Zoe Platt-Young

Appendix H: Educational Research Human Ethics Information Sheet and Consent Forms for Focus Groups

Department: Human Interface Technology Laboratory
Telephone: +64 27 481 5592
Email: zoe.platt-young@canterbury.ac.nz
16.03.2018

Using Human Centered Design and Qualitative Analysis to Design a Game Prototype for Social Skills Augmentation of Deaf and Hard-of-Hearing Students

Information Sheet for Teachers

Dear Teachers,

We are developing a game to support deaf student's social skills, and would like to invite you to take part in our research. We are creating this game in the hope that improved social skills will lead to better social, academic and employment outcomes for these students.

This study is being conducted by myself, Zoe Platt-Young, a Master of Human Interface Technology student, under the supervision of Dr. Simon Hoermann and Dr. Dean Sutherland. You have been identified as a possible participant because you're either a primary or secondary school teacher, or a Teacher of the Deaf. Your expert knowledge will be very helpful to include in the game design.

Purpose of the Focus Group: To discuss areas of social skills and communication related to deaf and hard of hearing students, social communication strategies, technology use, behaviour, accommodations and associated needs and experiences.

In the focus group session, I will introduce topics for discussion in a group format and you will be invited to contribute to the group conversation. Some areas that may be discussed are:

- Tools for building social skills of deaf and hard of hearing students
- Communication and social interaction needs of deaf and hard of hearing students
- Successful students and what you believe contributes to their success
- Behaviour management and emotional self-regulation of students
- Technology use and media requirements of deaf and hard of hearing students
- Hobbies, games and sports preferences or habits
- Stigma related to being deaf or hard of hearing
- Relationships with peers, friendship formation, bullying, positive social encounters

The format will be a semi-structured interview where you can contribute your ideas, thoughts and past experiences regarding the social experiences of your students with other teachers and parents of deaf and hard of hearing students.

Some participatory design exercises such as persona and scenario activities will take place as the research progresses. These activities are to improve the game so it properly meets the needs of deaf and hard of hearing students and so the game can be as accurate and engaging as possible.

An example of this would be to discuss a persona (an example/imaginary student) who is deaf or hard of hearing and what their usage of technology or the game might be like, for instance their device use of tablet and desktop computers, their social and communication challenges, multimedia preferences, what their interests might be, and what they might need to complete tasks.

Another design activity will be to look at an in-progress version of the game and to discuss as a group how it might be used by deaf and hard of hearing students and what might make it more user-friendly or interesting to students.

Participants and Researchers Present: There will be a maximum of 5-7 teachers and parents present including yourself, a Focus Group Moderator (myself, Zoe Platt-Young) and an Assistant/Observer – Zoe Haws, an Audiologist fluent in NZSL.

Location: van Asch Deaf Education Centre campus and/or satellite facilities around Christchurch

Time: March or April 2018

Duration: Between 90 minutes - two hours, with a short break midway

Withdrawing*: **participation is voluntary and you can decide not to participate. However, once the focus group starts it will not be possible to remove your data due to the group nature of the discussion. You are however able to leave the session at any time should you feel uncomfortable and not wish to continue.***

Data Collection*:* Conversational data from the focus group will be pseudonymised to protect your confidentiality before it is shared (in any transcripts you will be referred to via a pseudonym rather than by your real name). I will email you a summary of the focus group discussion if you indicate you wish to receive this by supplying an email address on the consent form.

Audio, Video and Photographic Recording in Focus Groups: Audio recordings, video and photographs will be taken during the focus group sessions to aid the research. No media featuring your recognisable image or voice will be shared with anyone beyond the researchers. If photographs are used in publications they will be blurred and/or a filter applied to obscure any parts of the image that would show your identity/that you participated in the session.

Data Storage: Data will be safely kept for no less than five years and then deleted. However, if required some pseudonymized data might be shared with other researchers if there is a reasonable scientific or educational need to do so.

Publication of Research: The results of this research will be published in my MHIT thesis, which will be available through the library of the University of Canterbury. Publication of the results in Human-Computer Interaction, social sciences, technology, scientific and/or medical outlets is envisioned as well as for communication and marketing purposes.

Major dissemination of this research will be announced on the Facebook page (www.facebook.com/HITLabNZ) as well as the webpage (hwww.hitlabnz.org/index.php/publications) of the HIT Lab NZ where a link to the publication will be provided.

I am carrying out this project in partial fulfilment of the Master of Human Interface Technology thesis under the supervision of Dr. Simon Hoermann (simon.hoermann@canterbury.ac.nz) and Dr. Dean Sutherland (dean.sutherland@canterbury.ac.nz), who will be pleased to discuss any concerns you may have about participation in the project.

Having read the information provided, you can decide whether you want to participate in this research project. This letter is yours to keep. As a next step you will be asked to complete the consent form that is to be returned to the researcher, Zoe Platt-Young.

This project has been reviewed and approved by the University of Canterbury Educational Research Human Ethics Committee, and participants should address any complaints to The Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

Department: Human Interface Technology Laboratory
Telephone: +64 27 481 5592
Email: zoe.platt-young@canterbury.ac.nz
16.03.2018

Using Human Centered Design and Qualitative Analysis to Design a Game Prototype for Social Skills Augmentation of Deaf and Hard-of-Hearing Students

Consent form for Teachers

- ☐ I have been given a full explanation of this project and have had the opportunity to ask questions.
- ☐ I understand what is required of me if I agree to take part in the research.
- ☐ I understand that participation is voluntary.
- ☐ I understand that the final time to withdraw my data is before the focus group session commences due to the nature of the group discussion format
- ☐ I understand that any information or opinions I provide will be kept confidential and that any published or reported results will not identify the participants. I understand that a thesis is a public document and will be available through the library of the University of Canterbury.
- ☐ I understand that all data collected for the study will be kept in locked and secure facilities and will be destroyed after five years.
- ☐ I understand that any photographic, video and audio recording media featuring my image or voice will not be shared with anyone beyond the researchers
- ☐ I understand that pseudonymised data might be shared with other researchers if there is a reasonable scientific or pedagogic need to do so
- ☐ I understand that I can access the Facebook page or the webpage of the HIT Lab NZ to find information about disseminations and summaries of the outcomes of this research once they become available
- ☐ I understand that I can contact the researcher, Zoe Platt-Young, or supervisor Dr. Simon Hoermann (simon.hoermann@canterbury.ac.nz) and Dr. Dean Sutherland (dean.sutherland@canterbury.ac.nz,) for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Educational Research Human Ethics Committee, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz)
- ☐ By signing below, I agree to participate in this research project.

*Name:*_____ *Signed:*_____ *Date:*_____

Email address *(for report of findings, if applicable)*:_____

Please return this Consent Form to Zoe (the researcher) via hard copy in-person or e-mail (zoe.platt-young@canterbury.ac.nz).

Appendix I: Prospero Protocol and Registration for Systematic Literature Review (Platt-Young & Hoermann, 2018)

Systematic review

1. * Review title.

Give the working title of the review, for example the one used for obtaining funding. Ideally the title should state succinctly the interventions or exposures being reviewed and the associated health or social problems. Where appropriate, the title should use the PI(E)COS structure to contain information on the Participants, Intervention (or Exposure) and Comparison groups, the Outcomes to be measured and Study designs to be included.

Computer-based interventions for social skills training of deaf and hard of hearing children and youths, and of interventions for ASD children and youths in which the area being studied is related to those also experienced by deaf and hard of hearing students

8 words remaining

2. Original language title.

For reviews in languages other than English, this field should be used to enter the title in the language of the review. This will be displayed together with the English language title.

50 words remaining

3. * Anticipated or actual start date.

Give the date when the systematic review commenced, or is expected to commence.

20/02/2018

4. * Anticipated completion date.

Give the date by which the review is expected to be completed.

31/05/2018

5. * Stage of review at time of this submission.

Indicate the stage of progress of the review by ticking the relevant Started and Completed boxes. Additional information may be added in the free text box provided.
Please note: Reviews that have progressed beyond the point of completing data extraction at the time of initial registration are not eligible for inclusion in PROSPERO. Should evidence of incorrect status and/or completion date being supplied at the time of submission come to light, the content of the PROSPERO record will be removed leaving only the title and named contact details and a statement that inaccuracies in the stage of the review date had been identified.
This field should be updated when any amendments are made to a published record and on completion and publication of the review.

The review has not yet started: No

Review stage	Started	Completed
Preliminary searches	Yes	Yes
Piloting of the study selection process	Yes	Yes
Formal screening of search results against eligibility criteria	Yes	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

Provide any other relevant information about the stage of the review here (e.g. Funded proposal, protocol not yet finalised).

6. * Named contact.

The named contact acts as the guarantor for the accuracy of the information presented in the register record.

Zoë Platt-Young

Email salutation (e.g. "Dr Smith" or "Joanne") for correspondence:

Zoë

7. * Named contact email.

Give the electronic mail address of the named contact.

zoe.platt-young@pg.canterbury.ac.nz or zoe@zoeplattyoung.com

8. Named contact address

Give the full postal address for the named contact.

John Britten Building
Cnr of Creyke and Engineering Rd
Ilam, Christchurch, New Zealand

9. Named contact phone number.

Give the telephone number for the named contact, including international dialling code.

+64 3 369-2226

10. * Organisational affiliation of the review.

Full title of the organisational affiliations for this review and website address if available. This field may be completed as 'None' if the review is not affiliated to any organisation.

Human Interface Technology Lab, University of Canterbury

Organisation web address:

https://www.hitlabnz.org/

11. Review team members and their organisational affiliations.

Give the title, first name, last name and the organisational affiliations of each member of the review team. Affiliation refers to groups or organisations to which review team members belong.

Ms Zoë Platt-Young. HIT Lab NZ, University of Canterbury

12. * Funding sources/sponsors.

Give details of the individuals, organizations, groups or other legal entities who take responsibility for initiating, managing, sponsoring and/or financing the review. Include any unique identification numbers assigned to the review by the individuals or bodies listed.

None

13. * Conflicts of interest.

List any conditions that could lead to actual or perceived undue influence on judgements concerning the main topic investigated in the review.

None

None specified.

14. Collaborators.

Give the name and affiliation of any individuals or organisations who are working on the review but who are not listed as review team members.

Dr Simon Hoermann. HIT Lab NZ, University of Canterbury

15. * Review question.

State the question(s) to be addressed by the review, clearly and precisely. Review questions may be specific or broad. It may be appropriate to break very broad questions down into a series of related more specific questions. Questions may be framed or refined using PI(E)COS where relevant.

How have computer-based technological interventions been used or created to address social skills of deaf and hard of hearing children and youth?
How have computer-based technological interventions been used to address specific social skills of autism spectrum disorder that overlap with social skills deficits that deaf and hard of hearing children and youth also experience?
What are some key findings from the research regarding promising interventions, the acceptance of interventions, related changes in participant behaviour or esteem, and user needs specific in the design of interventions for deaf and hard of hearing individuals?

158 words remaining

16. * Searches.

Give details of the sources to be searched, search dates (from and to), and any restrictions (e.g. language or publication period). The full search strategy is not required, but may be supplied as a link or attachment.

Database searches of the following sources were carried out: COMPENDEX (which indexes IEEE and ACM), EMBASE, MEDLINE, ICDVRAT, PsycINFO, Scopus, and Web of Science.
The search dates were from the earliest records available online to the present (February/March 2018).
Returned results that were not published in English are excluded.
The following search strategy was used for MEDLINE and will tailored for the format of each database: 1 social behavior/ or cooperative behavior/ or self-control/ or social adjustment/ or social skills/ (106842) 2 personal autonomy/ or resilience, psychological/ (18940) 3 Self Concept/ or Self Efficacy/ (67676) 4 adaptation, psychological/ or emotional adjustment/ (86185) 5 (social adj5 (adaptation or skills training or behav* or adjustment)).tw. (35523) 6 (self adj2 (concept or efficacy)).tw. (25124) 7 resilience.tw. (14416) 8 1 or 2 or 3 or 4 or 5 or 6 or 7 (300564) 9 Therapy, Computer-Assisted/ (6192) 10 games, recreational/ or video games/ (4014) 11 virtual reality/ (152) 12 user-computer interface/ (34070) 13 computer assisted.tw. (22465) 14 ((computer or video) adj3 gam*).tw. (4059) 15 virtual reality.tw. (6461) 16 augmented reality.tw. (1037) 17 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 (69959) 18 8 and 17 (1981) 19 exp Hearing Disorders/ (79687) 20 deaf*.ti. (16494) 21 hearing disorder*.ti. (1013) 22 exp Autism Spectrum Disorder/ (22890) 23 autis*.tw. (35760) 24 19 or 20 or 21 or 22 or 23 (121755) 25 18 and 24 (62)

Additional search strategy information can be found in the attached PDF document (link provided below).

46 words remaining

17. URL to search strategy.

Give a link to the search strategy or an example of a search strategy for a specific database if available (including the keywords that will be used in the search strategies).

https://www.crd.york.ac.uk/PROSPEROFILES/92708_STRATEGY_20180406.pdf

Alternatively, upload your search strategy to CRD in pdf format. Please note that by doing so you are consenting to the file being made publicly accessible.

Yes I give permission for this file to be made publicly available

18. * Condition or domain being studied.

Give a short description of the disease, condition or healthcare domain being studied. This could include health and wellbeing outcomes.

Social skills and self efficacy outcomes by way of technological interventions (games, computer-assisted therapies) for deaf and hard of hearing students, or computer-based interventions that have demonstrable social applications for deaf and hard of hearing students from the ASD field.

160 words remaining

19. * Participants/population.

Give summary criteria for the participants or populations being studied by the review. The preferred format includes details of both inclusion and exclusion criteria.

School-aged students between the ages of 6-21 who are deaf, hard of hearing or have ASD who have deficiencies in social skills, and who have received a computer-based intervention for social skills training.

Studies will be excluded if they largely describe an element of ASD that is not also related to deaf and hard of hearing students.
Studies will also be excluded if they include a prevalence of co-morbidity and if the technological intervention is not the focus of the intervention being investigated.

Deaf and hard of hearing criteria are:
Children and youths (between 6-21 years old);
If ASD: aspects related to deaf social skills, i.e., self-efficacy.

92 words remaining

20. * Intervention(s), exposure(s).

Give full and clear descriptions or definitions of the nature of the interventions or the exposures to be reviewed.

Interventions will be eligible for inclusion if they are computer or computer-game based, and focus on social skills, efficacy, self concept, social adjustment or resilience, e.g.: computer-assisted therapy; recreational games; video games; virtual reality simulations; and augmented reality interventions.
Robotic therapies will be excluded.

155 words remaining

21. * Comparator(s)/control.

Where relevant, give details of the alternatives against which the main subject/topic of the review will be compared (e.g. another intervention or a non-exposed control group). The preferred format includes details of both inclusion and exclusion criteria.

Not applicable: studies with and without control interventions will be included.

189 words remaining

22. * Types of study to be included.

Give details of the types of study (study designs) eligible for inclusion in the review. If there are no

restrictions on the types of study design eligible for inclusion, or certain study types are excluded, this should be stated. The preferred format includes details of both inclusion and exclusion criteria.
Comparative as well as formative studies will be included, as long as relevant technology/interventions are assessed with respect to patients/participants.
130 words remaining

23. Context.

Give summary details of the setting and other relevant characteristics which help define the inclusion or exclusion criteria.
250 words remaining

24. * Main outcome(s).

Give the pre-specified main (most important) outcomes of the review, including details of how the outcome is defined and measured and when these measurement are made, if these are part of the review inclusion criteria.
Social behaviour measures that assess the usability/applicability/feasibility of the technology.
189 words remaining

Timing and effect measures

200 words remaining

25. * Additional outcome(s).

List the pre-specified additional outcomes of the review, with a similar level of detail to that required for main outcomes. Where there are no additional outcomes please state ‘None’ or ‘Not applicable’ as appropriate to the review
None.
299 words remaining

Timing and effect measures

300 words remaining

26. Data extraction (selection and coding).

Give the procedure for selecting studies for the review and extracting data, including the number of researchers involved and how discrepancies will be resolved. List the data to be extracted.
Duplicates will be removed from the citations retrieved in the searches, and a first screening phase, focusing on the titles and abstracts of the remaining papers, will be undertaken to determine their eligibility for inclusion based on inclusion/exclusion criteria. In the second screening, the full texts of the studies identified as being potentially relevant will be obtained and comprehensively assessed against the inclusion criteria, and final decisions made regarding eligibility, a procedure which will be undertaken with Dr. Simon Hoermann. Possible discrepancies will be discussed and resolved among the researchers.
Papers meeting the eligibility criteria will be coded (thematically arranged) according to the intervention type, study type, patient or participant type and outcomes.
186 words remaining

27. * Risk of bias (quality) assessment.

State whether and how risk of bias will be assessed (including the number of researchers involved and how discrepancies will be resolved), how the quality of individual studies will be assessed, and whether and how this will influence the planned synthesis.
Due to the wide range of targeted studies, a risk of bias assessment for individual studies will not be carried out for this review.
176 words remaining

28. * Strategy for data synthesis.

Give the planned general approach to synthesis, e.g. whether aggregate or individual participant data will be used and whether a quantitative or narrative (descriptive) synthesis is planned. It is acceptable to state that a quantitative synthesis will be used if the included studies are sufficiently homogenous.
A thematic analysis, high-level numeric summary and narrative synthesis will be carried out.
287 words remaining

29. * Analysis of subgroups or subsets.

Give details of any plans for the separate presentation, exploration or analysis of different types of participants (e.g. by age, disease status, ethnicity, socioeconomic status, presence or absence or co-morbidities); different types of intervention (e.g. drug dose, presence or absence of particular components of intervention); different settings (e.g. country, acute or primary care sector, professional or family care); or different types of study (e.g. randomised or non-randomised).

Age and gender of participants;
Study types;
The nature of the intervention type.

228 words remaining

30. * Type and method of review.

Select the type of review and the review method from the lists below. Select the health area(s) of interest for your review.

Type of review

Cost effectiveness
No

Diagnostic
No

Epidemiologic
No

Individual patient data (IPD) meta-analysis
No

Intervention
Yes

Meta-analysis
No

Methodology
No

Narrative synthesis
No

Network meta-analysis
No

Pre-clinical
No

Prevention
No

Prognostic
No

Prospective meta-analysis (PMA)
No

Review of reviews
No

Service delivery
No

Synthesis of qualitative studies
No

Systematic review
Yes

Other
No

Health area of the review

Alcohol/substance misuse/abuse
No

Blood and immune system
No

Cancer
No

Cardiovascular
No

Care of the elderly
No

Child health
No

Complementary therapies
No

Crime and justice
No

Dental
No

Digestive system
No

Ear, nose and throat
Yes

Education
Yes

Endocrine and metabolic disorders
No

Eye disorders
No

General interest
No

Genetics
No

Health inequalities/health equity
No

Infections and infestations
No

International development
No

Mental health and behavioural conditions
Yes

Musculoskeletal
No

Neurological
No

Nursing
No

Obstetrics and gynaecology
No

Oral health

No

Palliative care
No

Perioperative care
No

Physiotherapy
No

Pregnancy and childbirth
No

Public health (including social determinants of health)
No

Rehabilitation
No

Respiratory disorders
No

Service delivery
No

Skin disorders
No

Social care
No

Surgery
No

Tropical Medicine
No

Urological
No

Wounds, injuries and accidents
No

Violence and abuse
No

31. Language.

Select each language individually to add it to the list below, use the bin icon to remove any added in error.
English

There is an English language summary.

32. Country.

Select the country in which the review is being carried out from the drop down list. For multi-national collaborations select all the countries involved.

New Zealand

33. Other registration details.

Give the name of any organisation where the systematic review title or protocol is registered (such as with The Campbell Collaboration, or The Joanna Briggs Institute) together with any unique identification number assigned. (N.B. Registration details for Cochrane protocols will be automatically entered). If extracted data will be stored and made available through a repository such as the Systematic Review Data Repository (SRDR), details and a link should be included here. If none, leave blank.

50 words remaining

34. Reference and/or URL for published protocol.

Give the citation and link for the published protocol, if there is one

Give the link to the published protocol.

Alternatively, upload your published protocol to CRD in pdf format. Please note that by doing so you are consenting to the file being made publicly accessible.

Yes I give permission for this file to be made publicly available

Please note that the information required in the PROSPERO registration form must be completed in full even if access to a protocol is given.

35. Dissemination plans.

Give brief details of plans for communicating essential messages from the review to the appropriate audiences.

The review will be published within my Master of Human Interface Technology thesis, the expected Submission date for which is August 2018.

Do you intend to publish the review on completion?

Yes

36. Keywords.

Give words or phrases that best describe the review. Separate keywords with a semicolon or new line. Keywords will help users find the review in the Register (the words do not appear in the public record but are included in searches). Be as specific and precise as possible. Avoid acronyms and abbreviations unless these are in wide use.

Technology interventions
Deaf and hard of hearing students
Computer assisted therapy

37. Details of any existing review of the same topic by the same authors.

Give details of earlier versions of the systematic review if an update of an existing review is being registered, including full bibliographic reference if possible.

50 words remaining

38. * Current review status.

Review status should be updated when the review is completed and when it is published.
Please provide anticipated publication date

Review_Ongoing

39. Any additional information.

Provide any other information the review team feel is relevant to the registration of the review.

40. Details of final report/publication(s).

This field should be left empty until details of the completed review are available.

Give the link to the published review.

Appendix J: Question Prompts

Questions/ Activities

Key: Blue= **Intro**. Green: **Reflective Qs.** Yellow: **Active Ideation**. Orange = **Summary**

Setup

Greeting participants
Refreshment offered
Consent obtained
Introductions
Explanation of project

Q1 Can you talk through your role?
Q2: What drew you to the role?
Q3: Age range of students?
Q4: How many students work with? Hearing statuses?
Q5: What are some goals you have with your students? How can students be encouraged with goals?
Q6: How did they define these goals in particular?
Q7: Have you seen this with other students?
Q8: What motivates your students?
Q9: What do you see as the biggest challenge to DHH self esteem and comm confidence?
Q10: What would or could help?
Q11: What activities do you do with your students?
Q12: Do you play games with your students?/ Or do they play games on their own or with friends?
Q13: What is your perspective on computer and mobile device use? Does this differ from your students? How so?
Q14: What assistive tech or accomodations are used in mainstream classes for student success? What do these help with/how used?
Q15: Which situations prove most challenging to students? Where/when/how
Q16: Strategies for communication - existing ones or ideas for improvements?
Q17: Which activities reinforce social habits?
Q18: How are your students relationships with hearing peers? What helps to build their relationships with others?
Q19: What is your impression regarding stigma? Do you think your students experience stigma? If so, how can they move past this? If not - what do you think has helped?
Q20: When are your students most themselves/ most confident? What do they take pride in and why/how?
A1: Any hobbies your students enjoy? From your perspective could these be used for additional learning? How?
A2: What would a game or tool for social skills and communication need to have, to meet needs of DHH students?
A3: What would it need to have to be fun and enjoyable to use?

A4: A student is faced with a frustrating situation where they can't understand others outside the classroom, what do you think the response would be? What would help or hinder problem solving?
A5: What would media requirements for the game/app be? ie…text?
A6: Ideas for scenes, places or situations that would be helpful to role play or have in the game?
A7: What would success for your DHH students look like?
A8: Ideas about resources and tools for students that you feel interesting that exist? What would you change, incorporate or keep the same?
A9: In an ideal world, what could the game be or do?
A10: What elements of d/Deaf culture would you see included?
Thanks for your time! Now, do you have any questions for us?
How could we improve future sessions? Thanks for your time and please get in touch if anything occurs to you after the session.
Incentives given.

Appendix K: NVivo Code List for Thematic Codes Developed for Primary Data

Name	Files	References
Games and User Experience	13	35
Characters	6	51
Consolidation games	8	24
Creation in game by players	1	2
Emotions to be triggered by games	1	1
Game augmentation	1	1
Game genre	2	2
Game Mechanics	7	25
Calibration	1	2
Choice	4	19
Instructions and Rules	7	13
Interactivity and Multiplayer	10	24
Levels and Progression	10	38
Age	10	33
Challenge	3	5
Personalised feedback	1	1
Reward and Player Motivation	7	36
Signposting success or goal	2	5
Visual reinforcement and feedback	9	23
Game UX	8	46
Gameplay	8	13
Availability of Physically Co-located players	1	1
Collaboration and Competition	4	10
Fun and Engagement	1	5
Losing and Winning	1	1
Games and digital tools used by teacher	9	55
Teacher and school current usage of games	5	11
Games and student preferences	6	52
Games as conversation medium with peers	4	5
Media and Interface	6	28
Continuity	1	2
Parental restrictions on use	1	2
Technology Device Use and Aptitude	8	22
User Experience of existing technology apps and interventions	12	105
Outdoor play	8	10
Parent recommendations for the game	4	24
Peer to peer game coaching	2	4
Perception of the game	4	7
Player base characteristics	1	1
role play	3	5
Sensory reinforcement	4	13
Task size and success	1	1
Teacher and Parent game experience	4	5
Teacher perception and support of game and research area	4	12
Teacher recommendations for the game (what could it ideally do)	11	256

Teacher reinforcement and support of game outcomes'	2	4
Identity, Culture and Relationships	9	85
Stigma and acceptance	14	122
Labeling and Disibility	1	2
Safe spaces	1	1
Student attitudes to Deafness	3	6
Student demographics	7	32
Gender	7	23
Interests and Hobbies	8	36
DHH Student awareness of social communication difficulties	1	4
Rituals	2	3
Comorbidity or health issues	1	3
Resources	3	8
External Support for DHH students	1	2
School programs for DHH students	2	3
Accomodations and Modifications	3	12
Relationships	7	25
Communication and interaction between parents of DHH students a	4	9
Family dynamics and Deafness	14	74
Humour	2	2
Parent descriptions of DHH children	3	5
Parent Occupation	1	1
Parental Experience	2	3
Parental Resources	2	2
Sibling relationships	3	3
Teacher perceptions of family support of the DHH student	2	3
Friendships	12	41
Stability of Friendships	1	3
Relationships with hearing peers	12	37
Societal inclusion	14	82
Normalising	5	14
Nature of the Hearing Impairment	4	6
Global Delay	1	2
Hearing and Audiological Devices	12	77
Customisation of devices	1	3
Device use	4	9
Fear of new sounds	1	3
Naming of devices	2	2
Goals	6	24
Achievable or Realistic Goals	1	3
DHH student goals	5	14
Student SD and Goal Setting	5	7
IEP goals	7	14
Parent and Teacher shared goals	2	4
Parent goals for their children	5	19
RTD and Educator Goals for DHH students	5	14
Success Criteria	3	10

Examples of successful outcomes or modeling	2	3
Picturing success	1	1
Subgoals or steps to achieve the goal	1	1
Connection to Deaf community, DHH peers and role models	12	109
Cultural Dimensions of Deafness	6	54
Transition	7	40
Social Skills, Communication and Pragmatics	15	131
Conversational repair and questioning	10	59
Contextual Barriers and Scenario (scene) inspirations	14	223
Body language	4	6
Social emotional areas	8	35
Academic	8	20
Vocabulary	11	33
Keeping up with other students	2	3
Self advocacy and self efficacy	11	104
Communication Modality	8	35
Attitude to and use of NZSL	9	60
Conversational Ability	3	5
Language modality and significance	5	18
Lipreading and looking	1	2
Visual communication tools	4	7
Interactions	7	9
Curiousity	3	5
Participation in conversations and activities	7	18
Teamwork	1	2
Cognition	5	11
Focusing	2	2
Social processing	2	3
Theory of Mind and Executive Function	4	16
Hearing peers strategies to support conversation with the DHH studer	2	4
Risk taking and problem solving	7	34
Subtleties, Social Nuance and Inferencing	8	16
Reading Comprehension	2	2
Categorization functions and labeling	2	5
Educator Experience w DHH Students	7	68
Classroom integration	2	2
Educator Role	11	44
School philosophy	6	8
Learning Strategies	12	47
Classroom integration	2	2
DHH student observation and modeling of hearing peers	2	2
Explicit teaching	9	31
Home learning	7	14
Incidental learning and osmosis	7	15
Review	11	30
Role Play	6	13
Scaffolding and associated knowledge	7	19

Resources	5	13
External Support for DHH students	6	12
School programs for DHH students	2	3
Accomodations and Modifications	10	51
Teacher exp as being DHH	5	10
Teacher interventions for social communication	2	17
Collaborative teacher projects for social communication	1	3
Learning Resources	6	10
Outcomes	1	1
Teacher perception of student social skills	3	7
Teacher observation and monitoring of DHH student behaviour	3	6
Variability of student social challenges	6	15